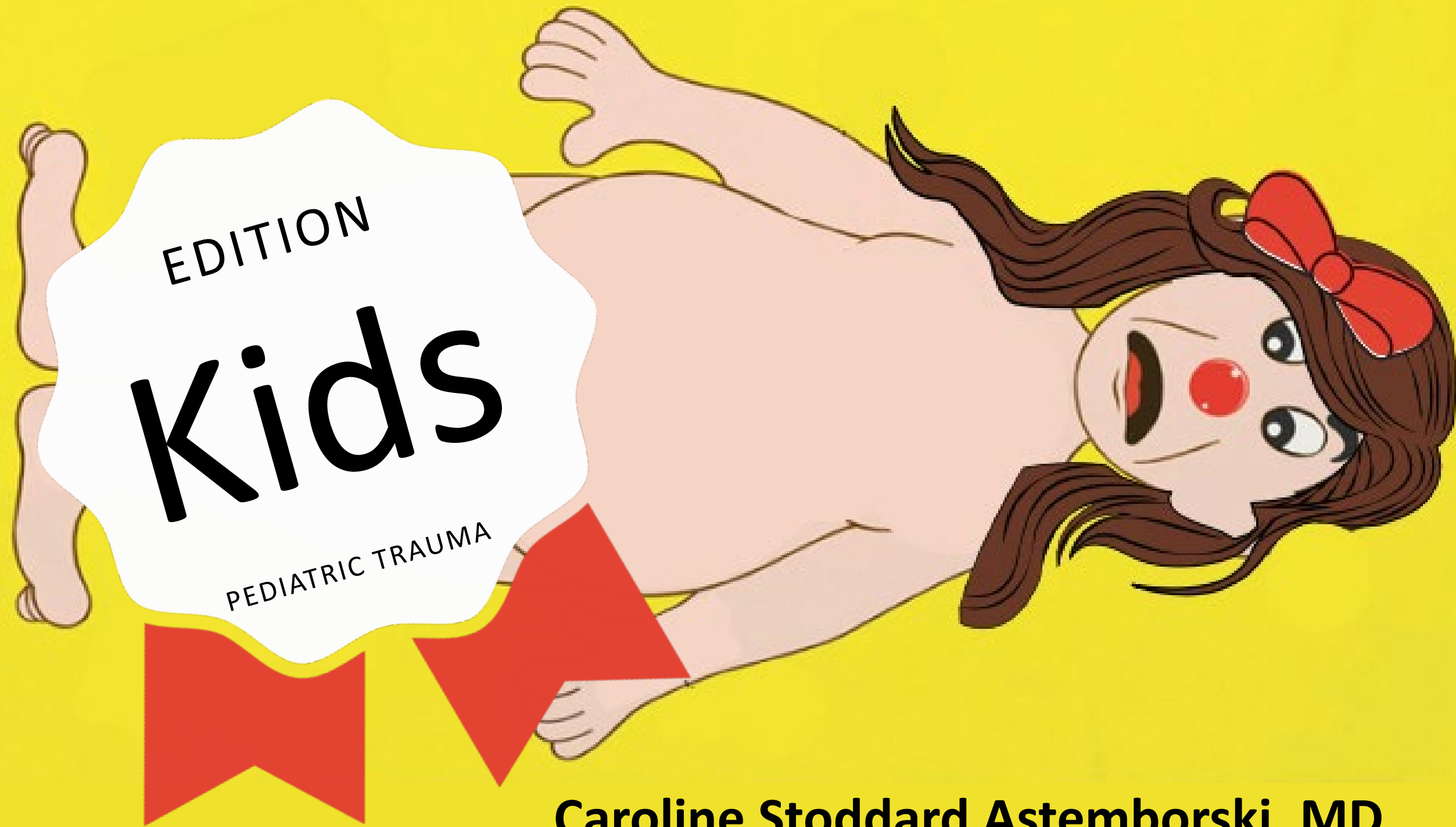


OPERATION



EDITION

Kids

PEDIATRIC TRAUMA

Caroline Stoddard Astemborski, MD
Prisma Health Upstate

Disclosures:

Caroline Stoddard Astemborski, MD

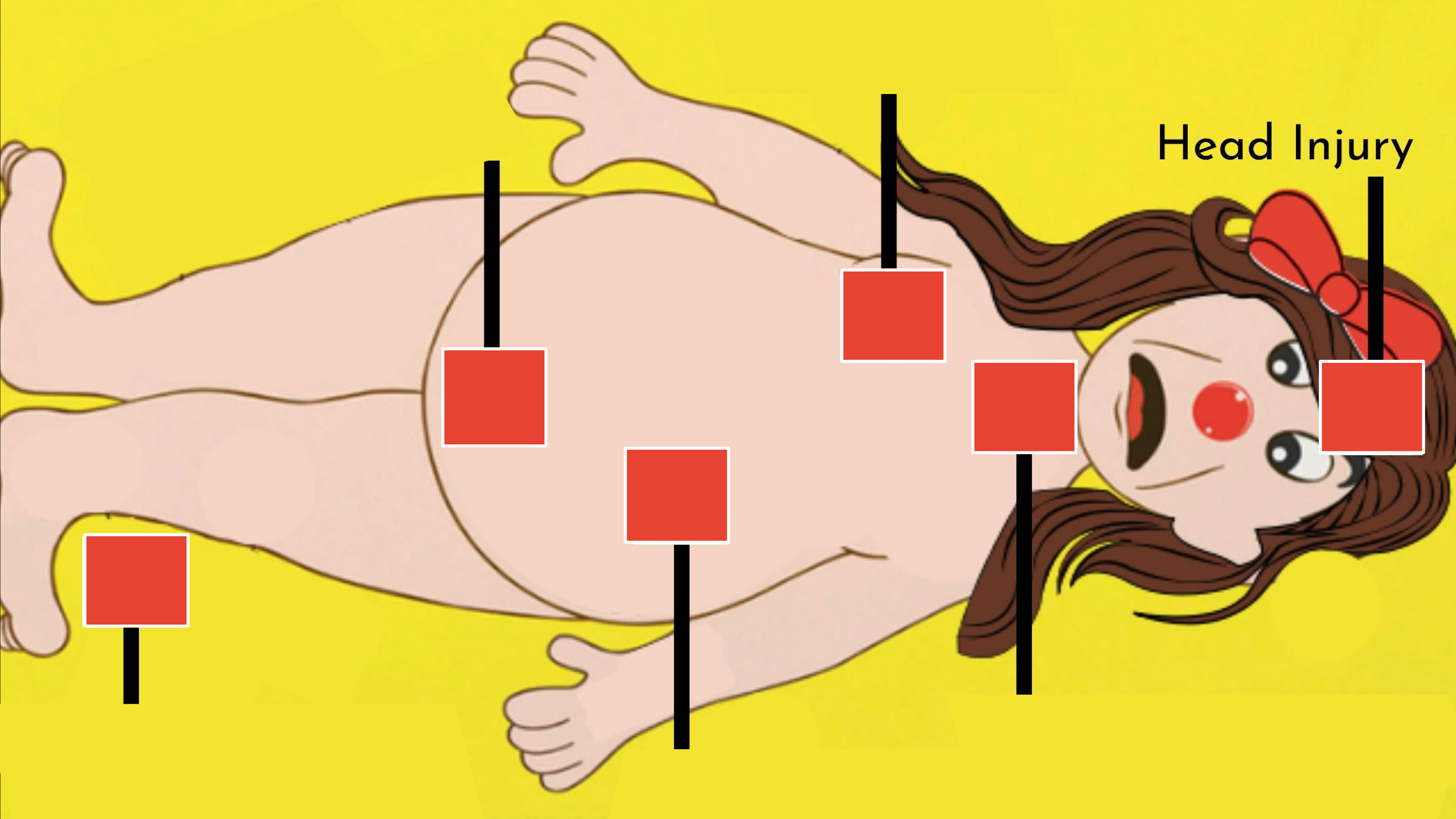
I have no relevant financial disclosures

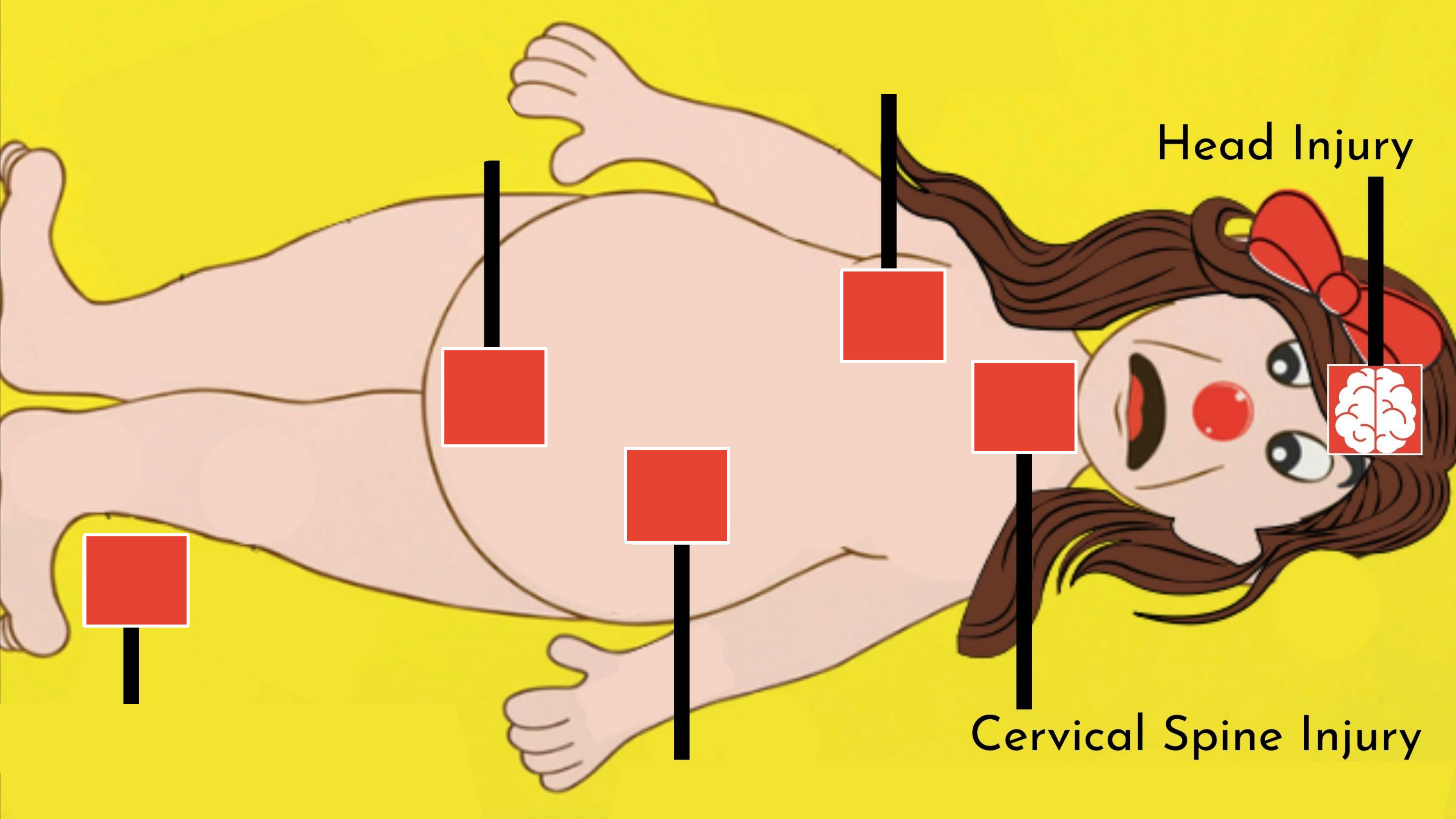
ATL

ADVANCED TRA



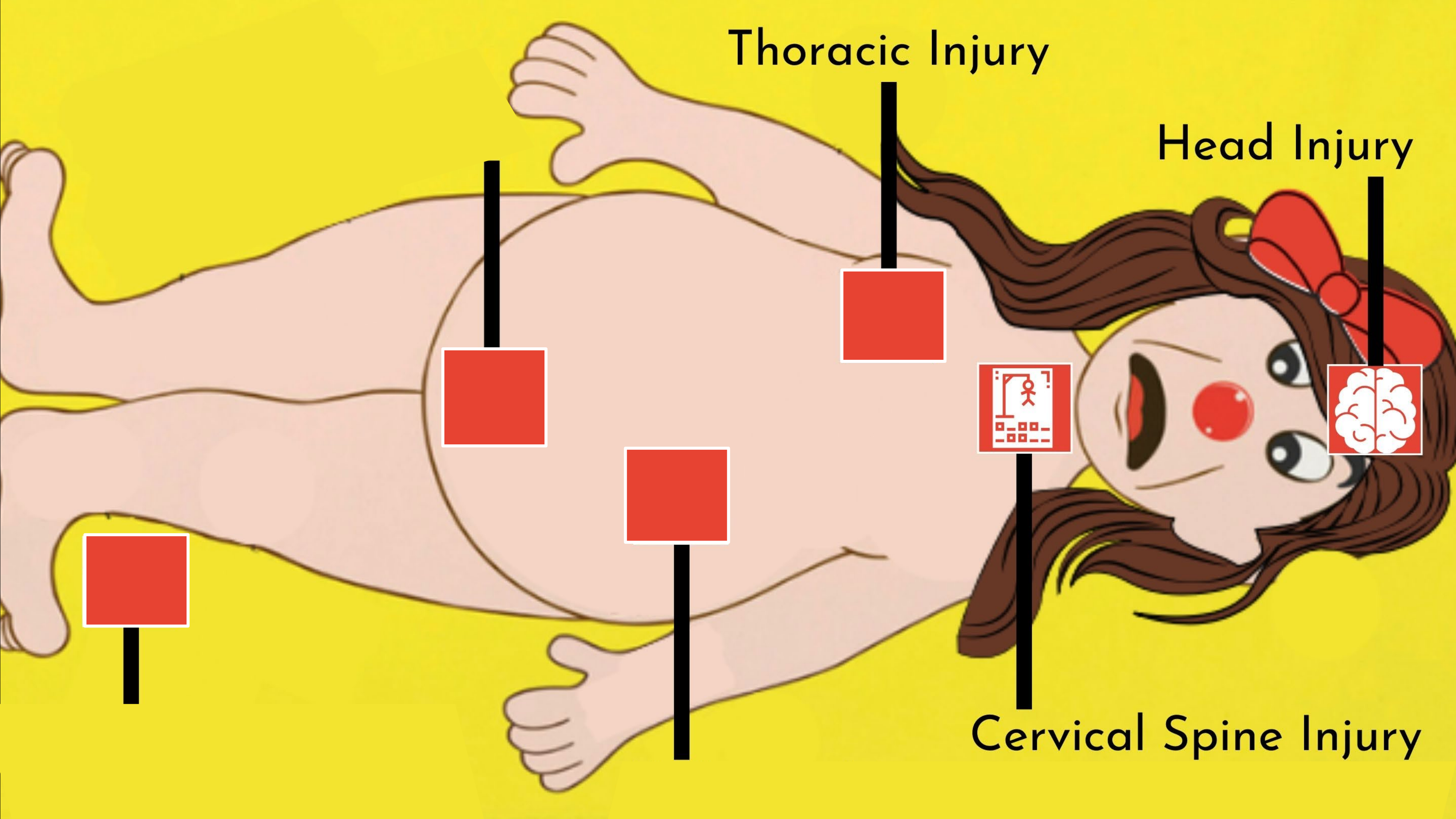
Head Injury





Head Injury

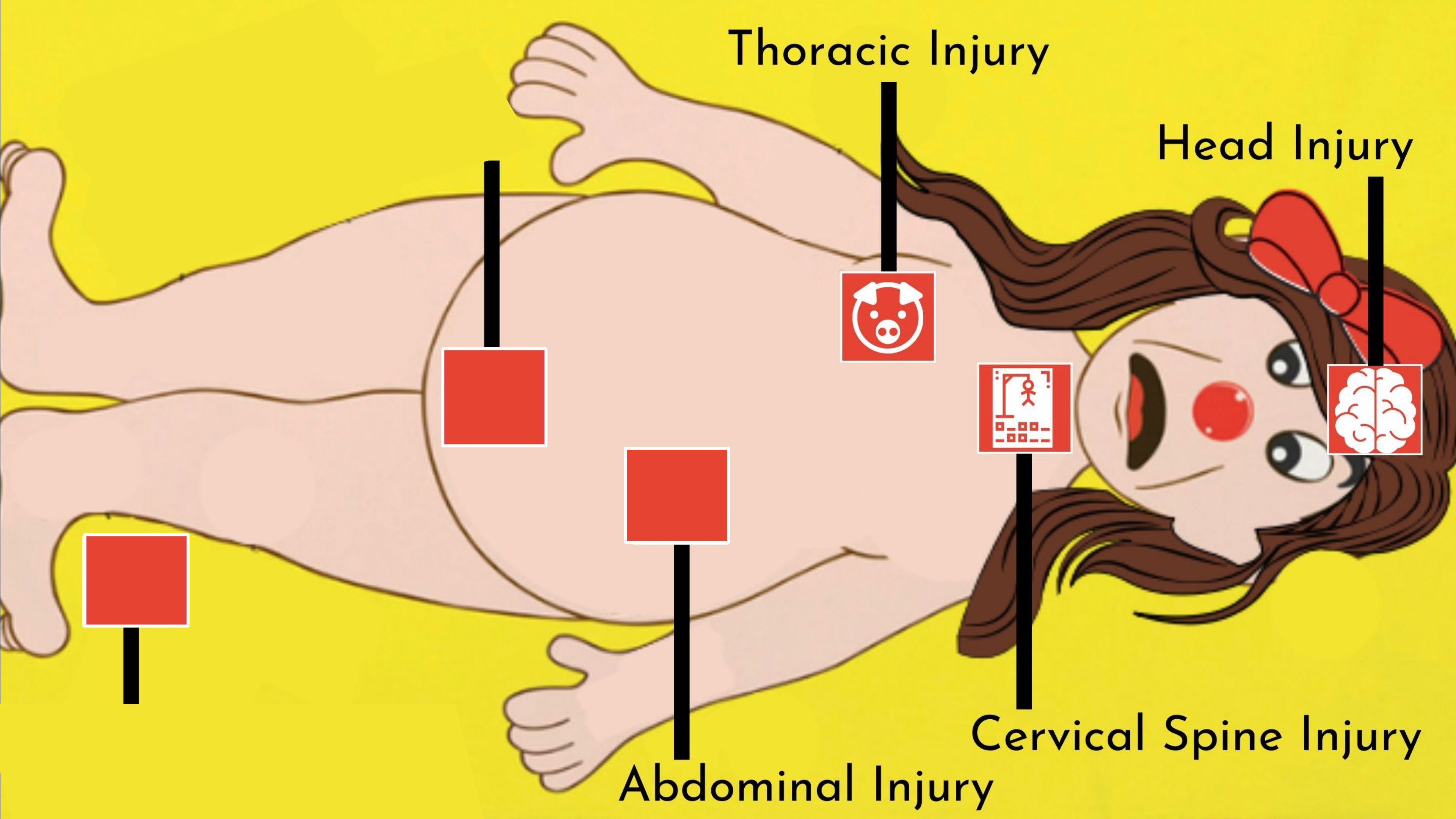
Cervical Spine Injury



Thoracic Injury

Head Injury

Cervical Spine Injury

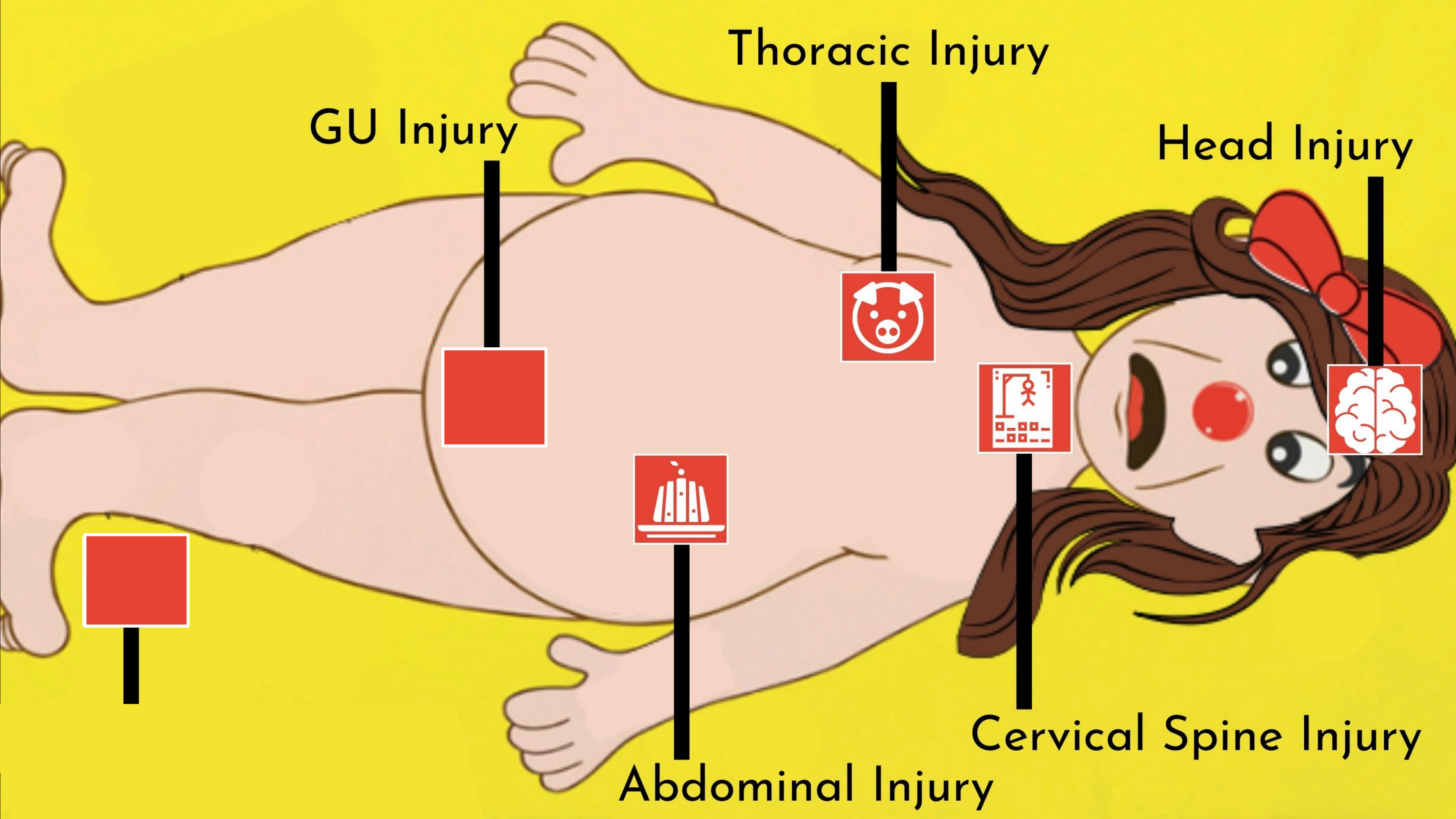


Thoracic Injury

Head Injury

Cervical Spine Injury

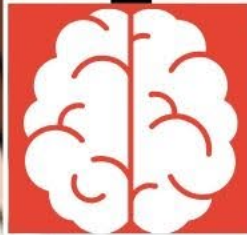
Abdominal Injury



Thoracic Injury

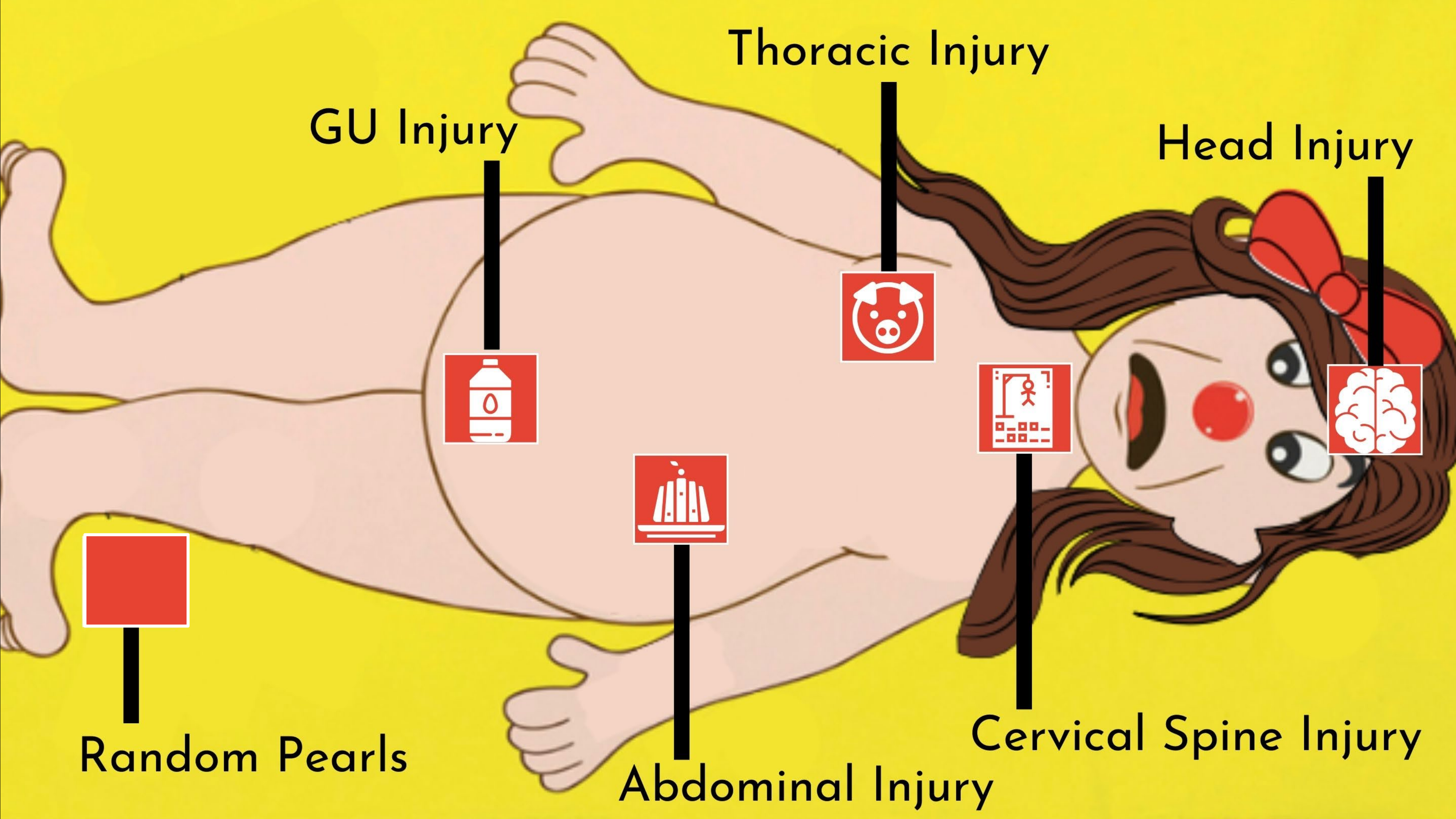
GU Injury

Head Injury



Cervical Spine Injury

Abdominal Injury



Thoracic Injury

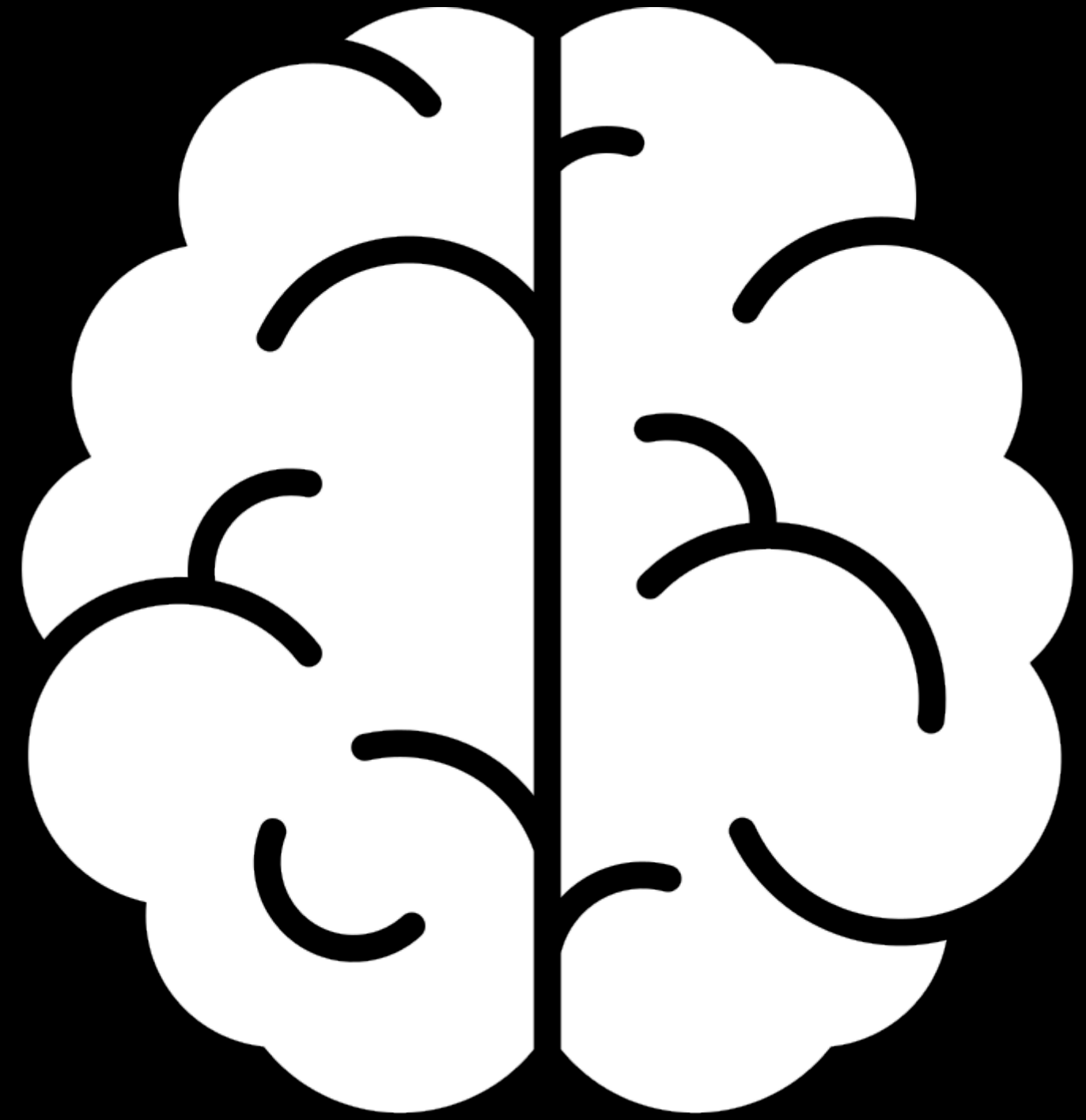
GU Injury

Head Injury

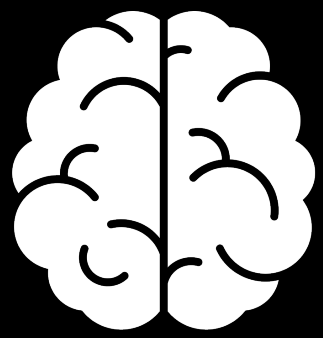
Random Pearls

Abdominal Injury

Cervical Spine Injury

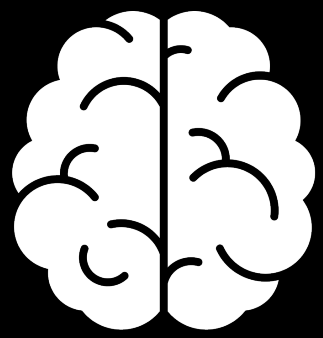


Head Injury Pearls



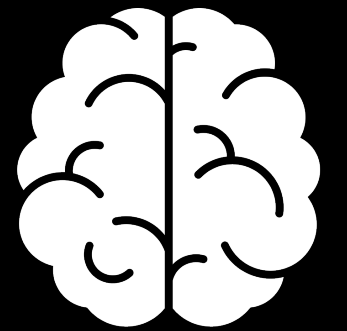
Which of the following patients with a closed head injury does not require a head CT?

- a. 15yo w/ initial GCS of 14
- b. 18mo w/ a palpable skull fracture
- c. 12yo w/ hemotympanum and mastoid ecchymosis
- d. 15mo w/ two episodes of emesis after a fall



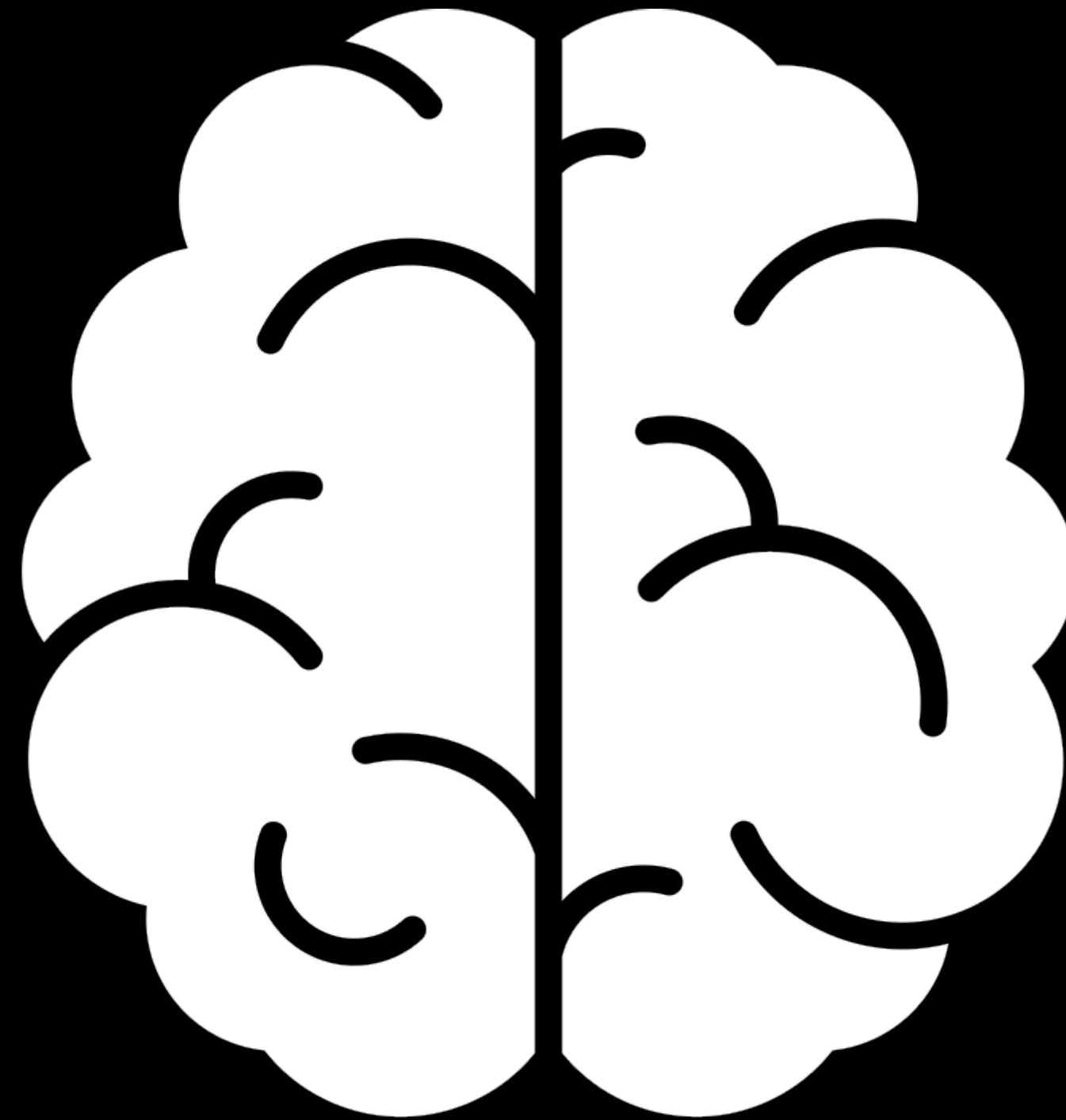
Which of the following patients with a closed head injury does not require a head CT?

If you answered a. 15yo with initial GCS of 14...

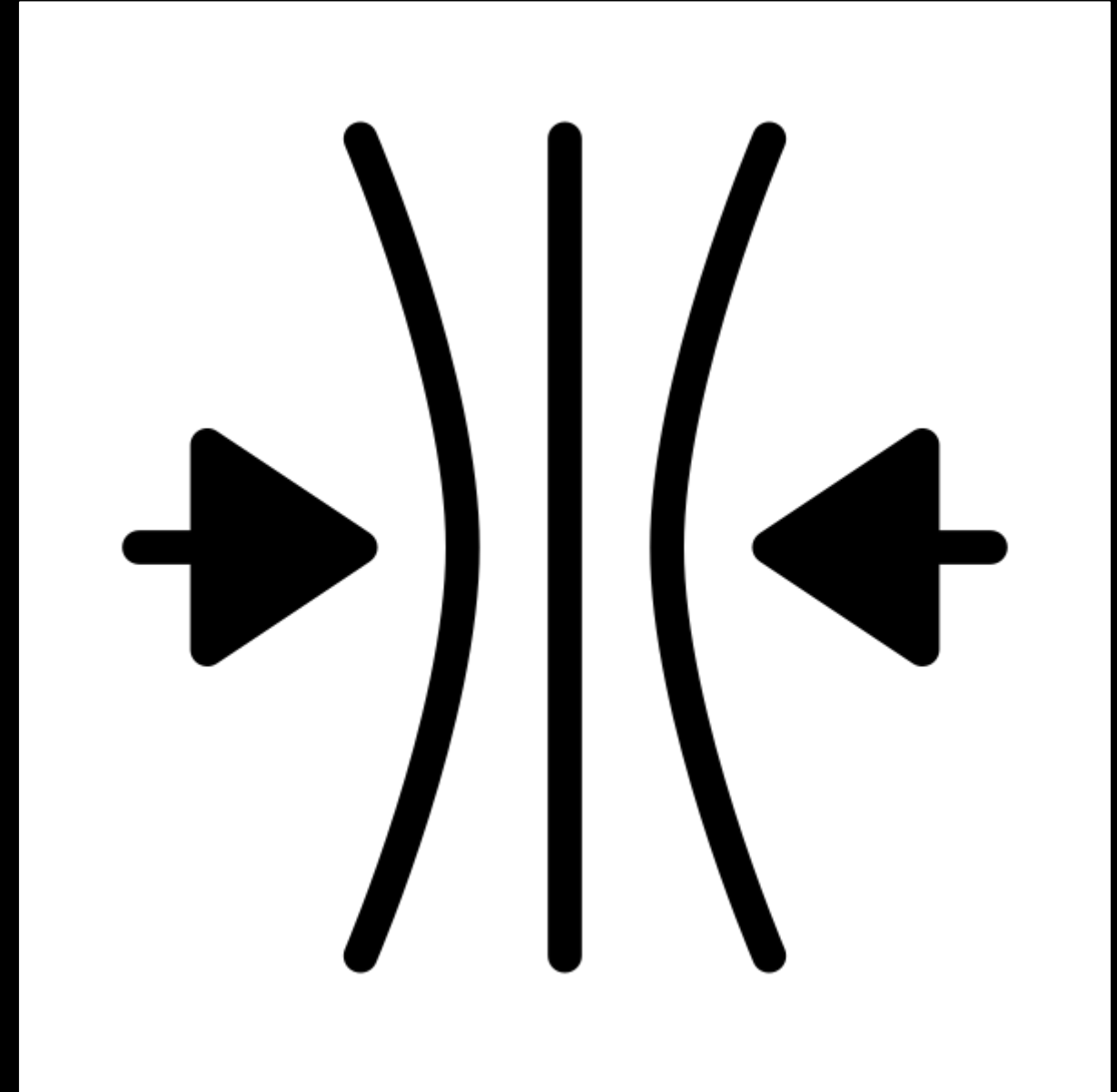
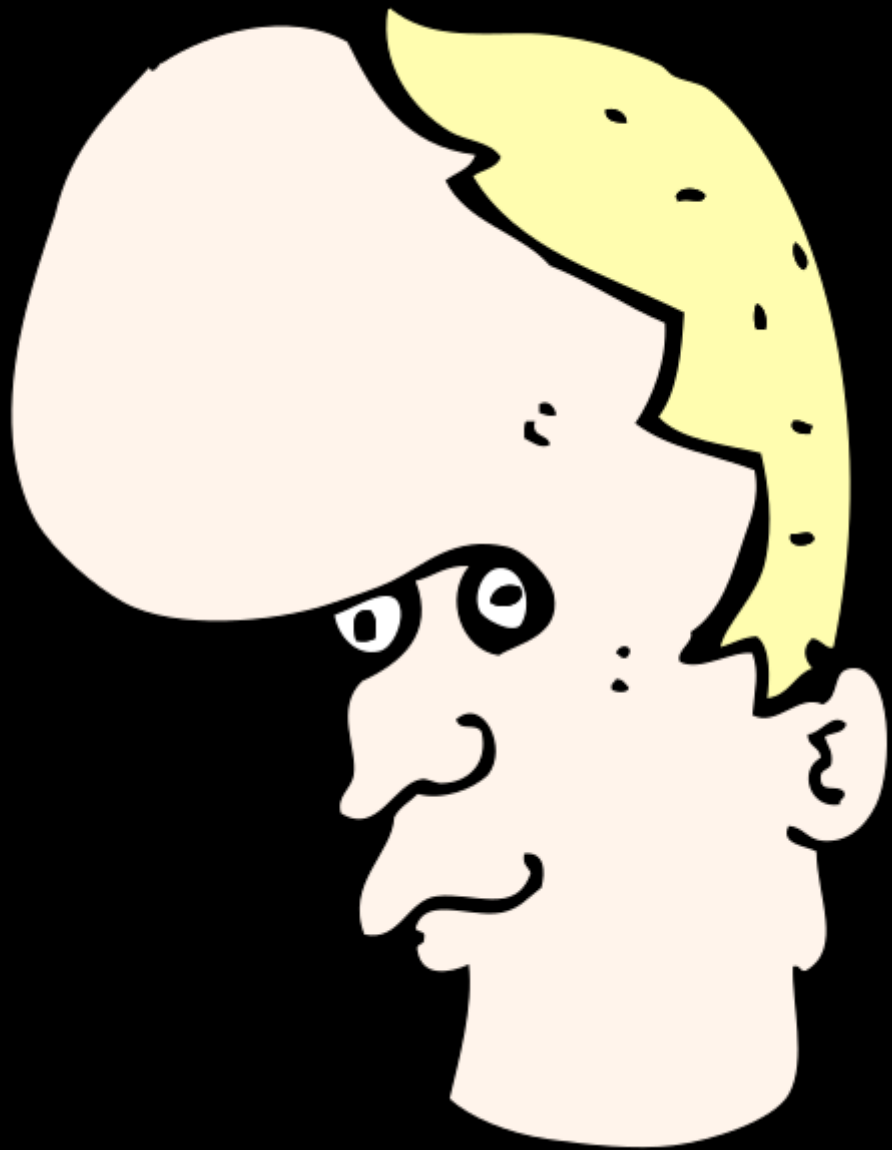
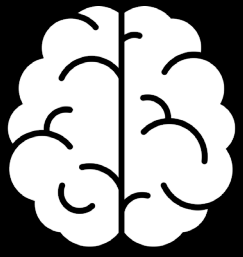


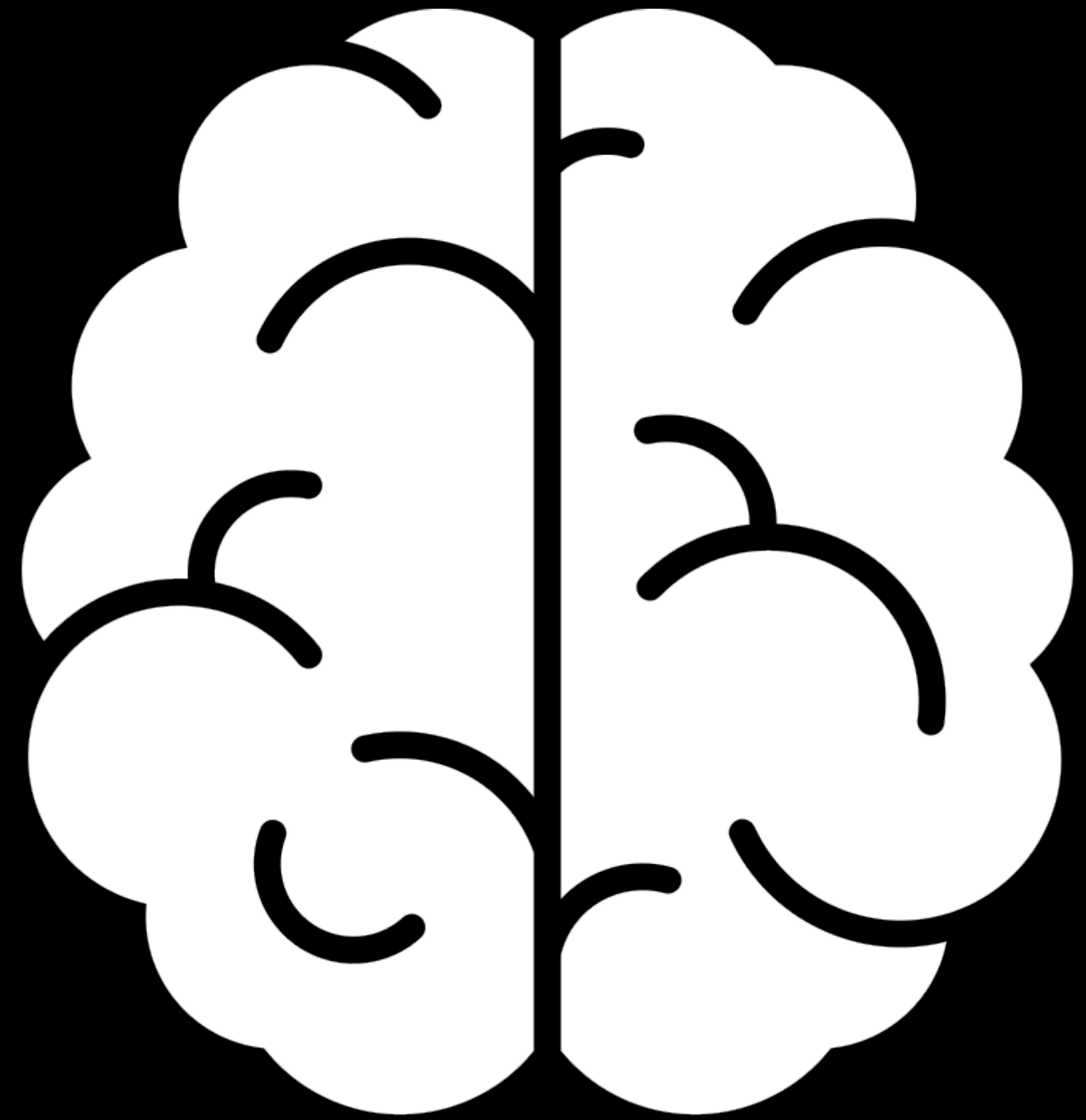
If you answered b, c, d...



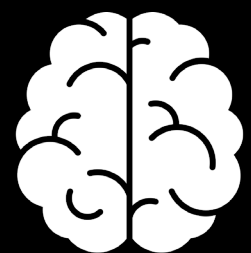


Anatomical Differences



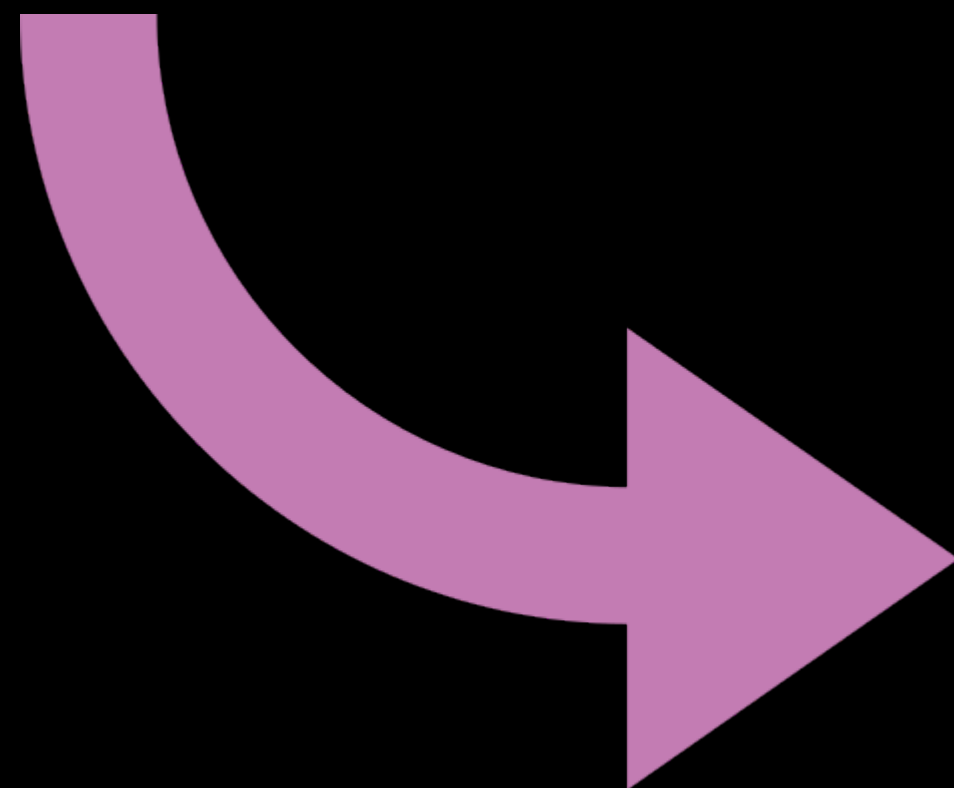


How to Assess?

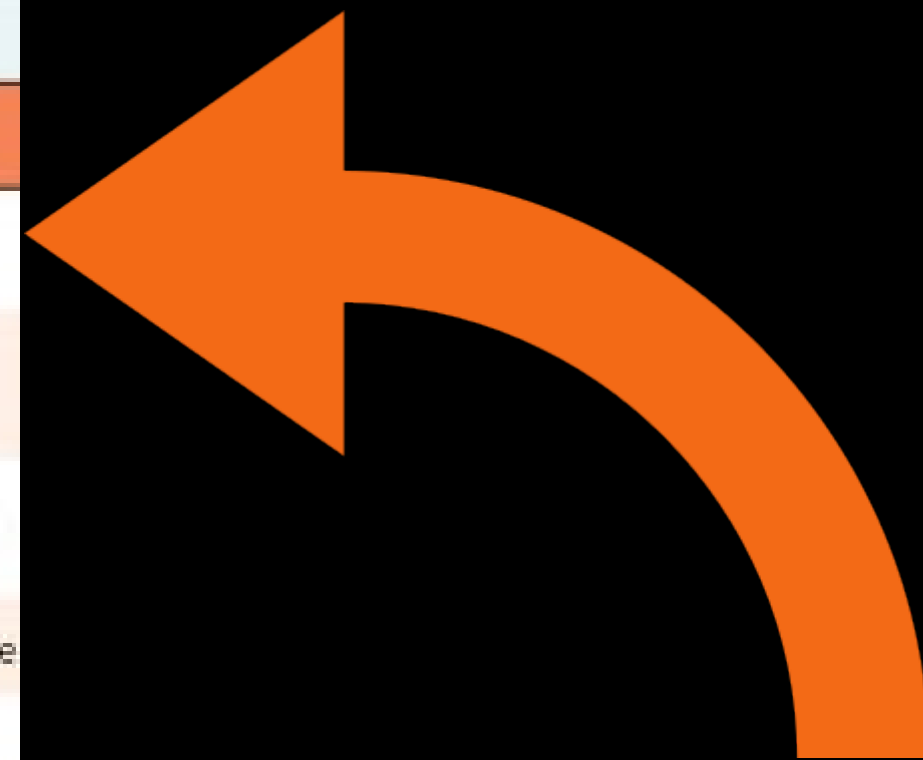


Motor

- Spontaneous?
- Commands?

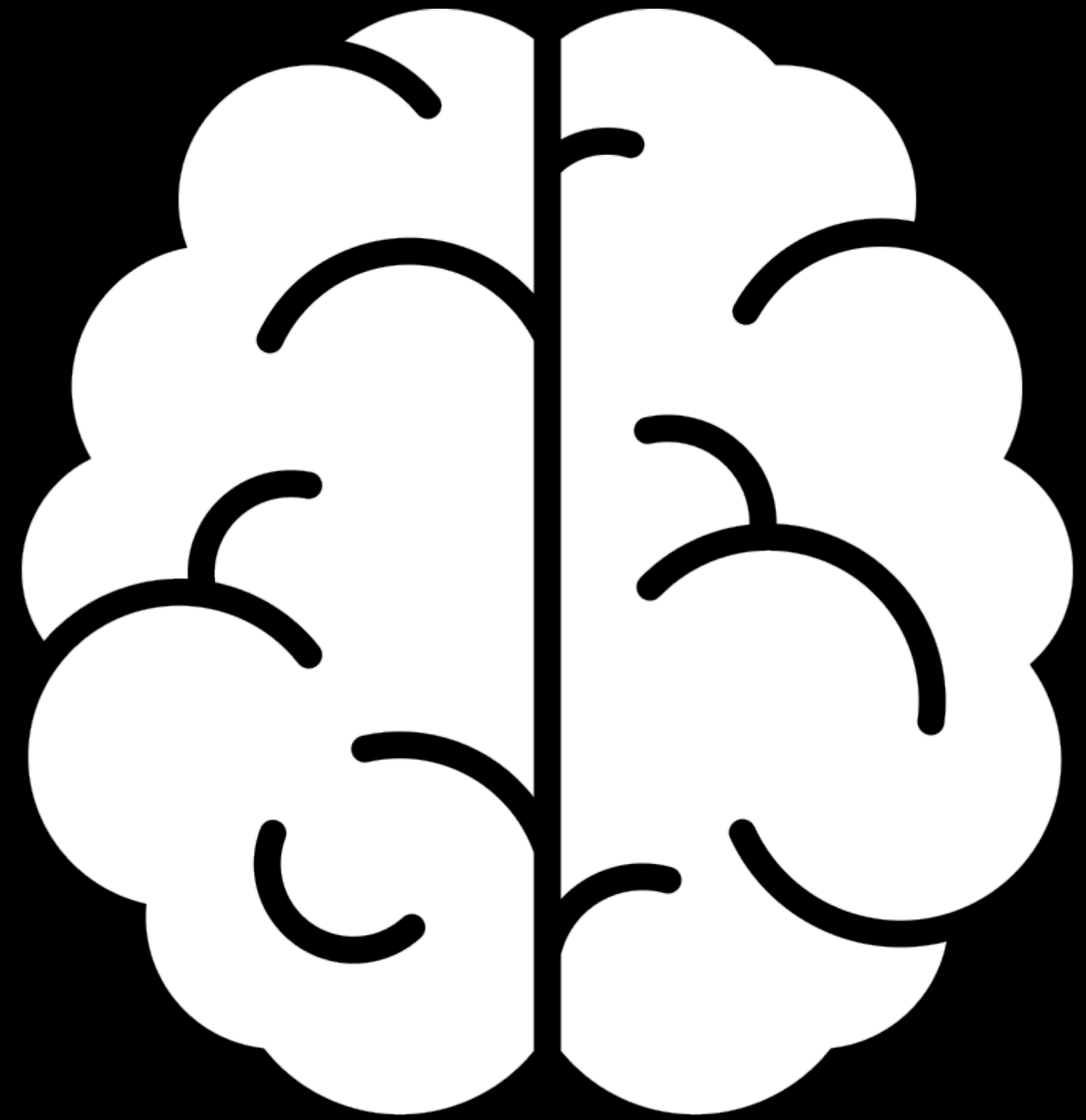


	Infant <1 yr	Child 1-4yrs	Age 4-Adult
EYES			
4	Open	Open	Open
3	To voice	To voice	To voice
2	To pain	To pain	To pain
1	No response	No response	No response
VERBAL			
5	Coos, babbles	Oriented, speaks, interacts, social	Oriented and alert
4	Irritable cry, consolable	Confused speech, disoriented, consolable	Disoriented
3	Cries persistently to pain	Inappropriate words, inconsolable	Nonsensical speech
2	Moans to pain	Incomprehensible, agitated	Moans, unintelligible
1	No response	No response	No response
MOTOR			
6	Normal, spontaneous movement	Normal, spontaneous movement	Follows commands
5	Withdraws to touch	Localizes pain	Localizes pain
4	Withdraws to pain	Withdraws to pain	Withdraws to pain
3	Decorticate flexion	Decorticate flexion	Decorticate flexion
2	Decerebrate extension	Decerebrate extension	Decerebrate extension
1	No response	No response	No response

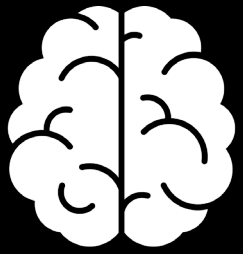


Verbal

- Spontaneous?
- Social?



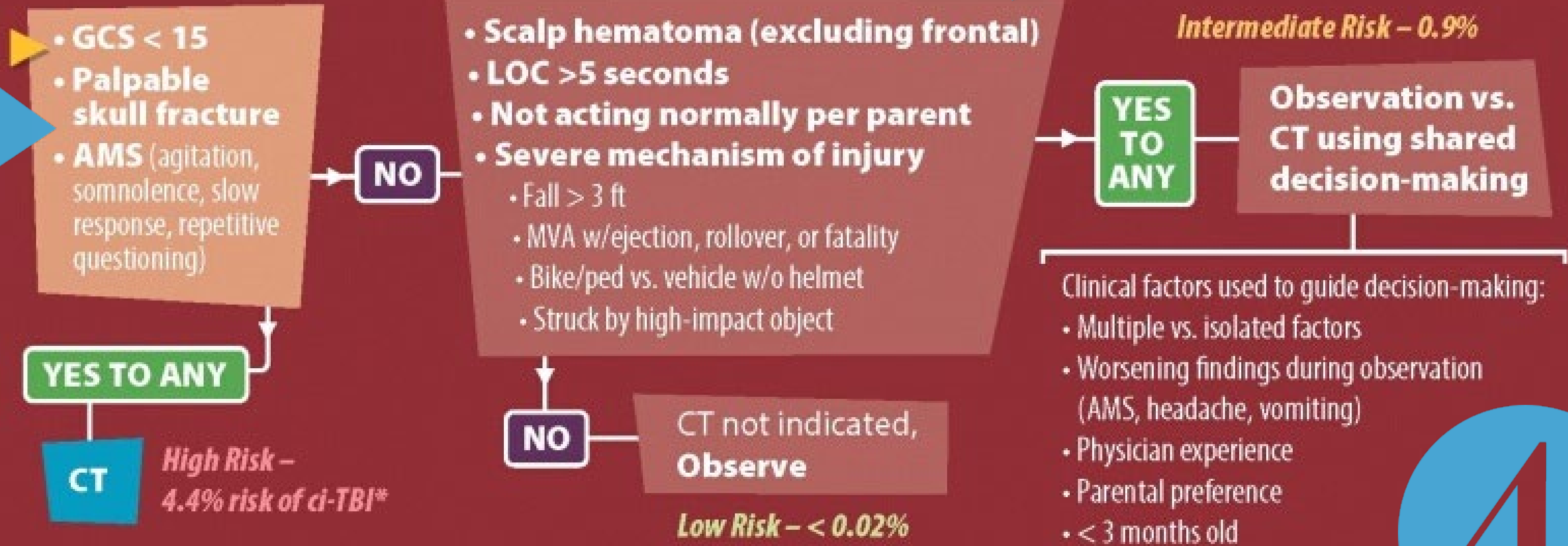
Who to Image?



Pediatric Head Trauma CT Decision Guide

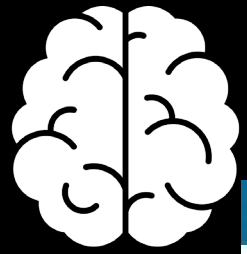
Children younger than 2 years

**UNDER
2 YEARS**



*ci-TBI: risk of clinically important TBI needing acute intervention, based on PECARN validated prediction rules





A California ACEP/Choosing Wisely Collaboration



Pediatric Head Trauma CT Decision Guide

Children 2 years and older

2 YEARS & OLDER

- GCS < 15
- Signs of basilar skull fracture
- AMS (agitation, somnolence, slow response, repetitive questions)

NO

YES TO ANY

CT
High Risk – 4.3% risk of ci-TBI*

- Vomiting
- LOC
- Severe headache
- Severe mechanism of injury
 - Fall > 5 ft
 - MVA w/ejection, rollover, or fatality
 - Bike/ped vs. vehicle w/o helmet
 - Struck by high-impact object

NO

CT not indicated,
Observe
Low Risk – < 0.05%

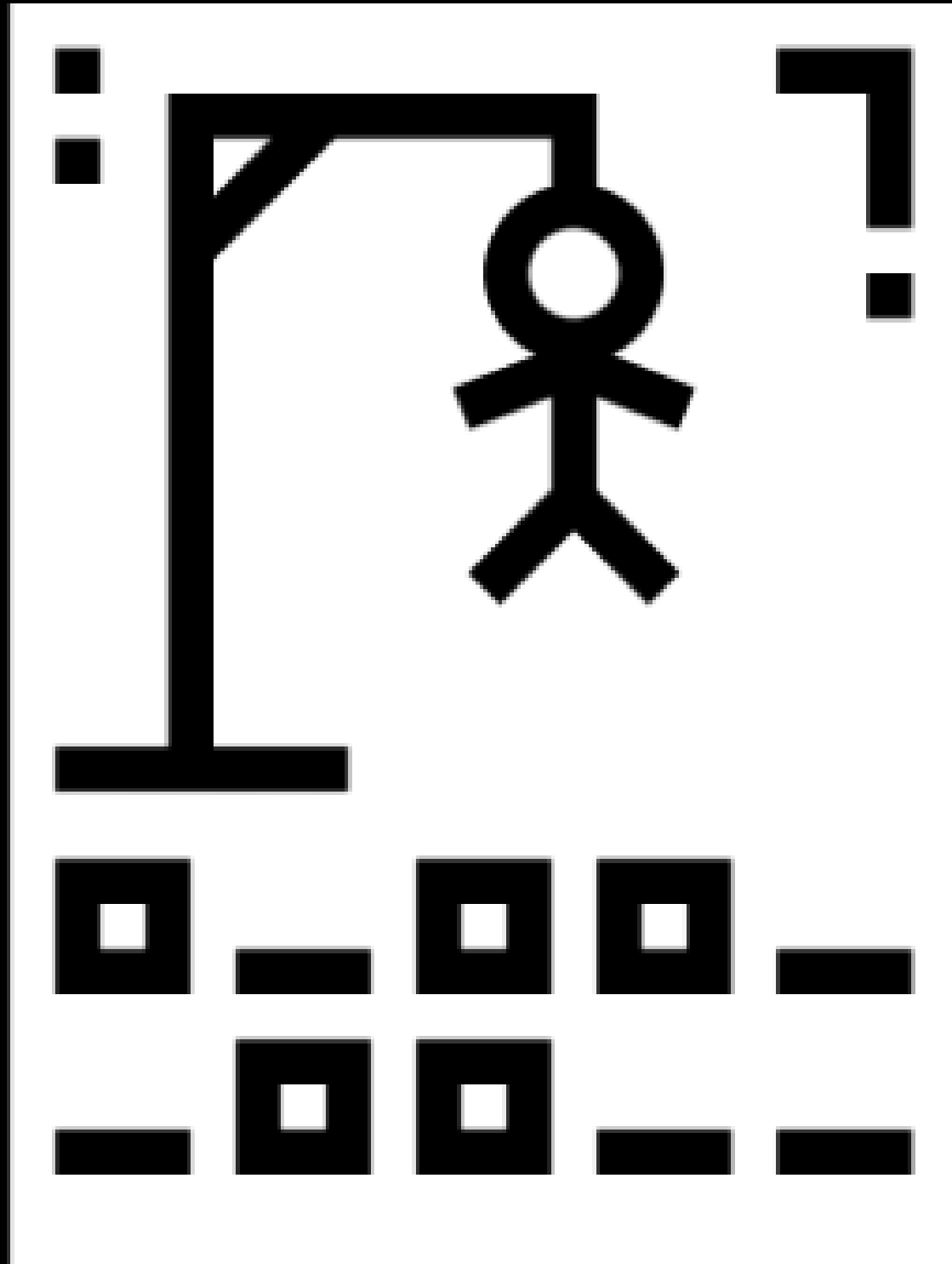
YES TO ANY

Intermediate Risk – 0.8%
Observation vs. CT using shared decision-making

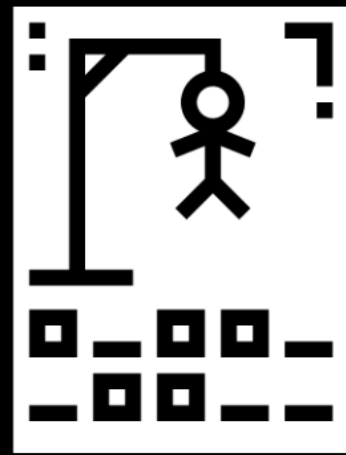
- Clinical factors used to guide decision-making:
- Multiple vs. isolated factors
 - Worsening findings during observation (AMS, headache, vomiting)
 - Physician experience
 - Parental preference

4

*ci-TBI: risk of clinically important TBI needing acute intervention, based on PECARN validated prediction rules

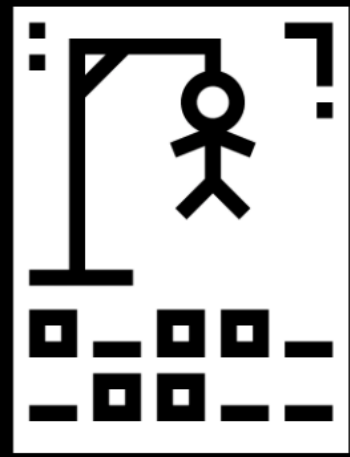


Cervical Spine Pearls



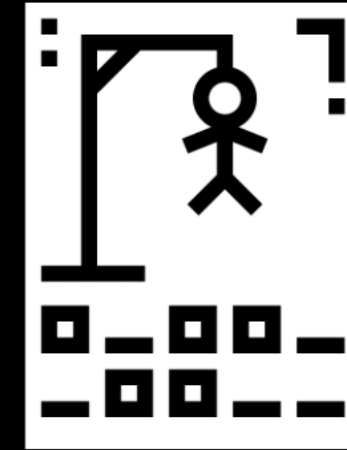
6yo boy falls from a second story window. He is alert with GCS of 15. No spinal tenderness, no focal neuro deficit or no distracting injuries. What is the most appropriate management?

- a. Remove collar and discharge home
- b. Plain radiography
- c. CT imaging
- d. Keep collar and re-examine in 1 hour



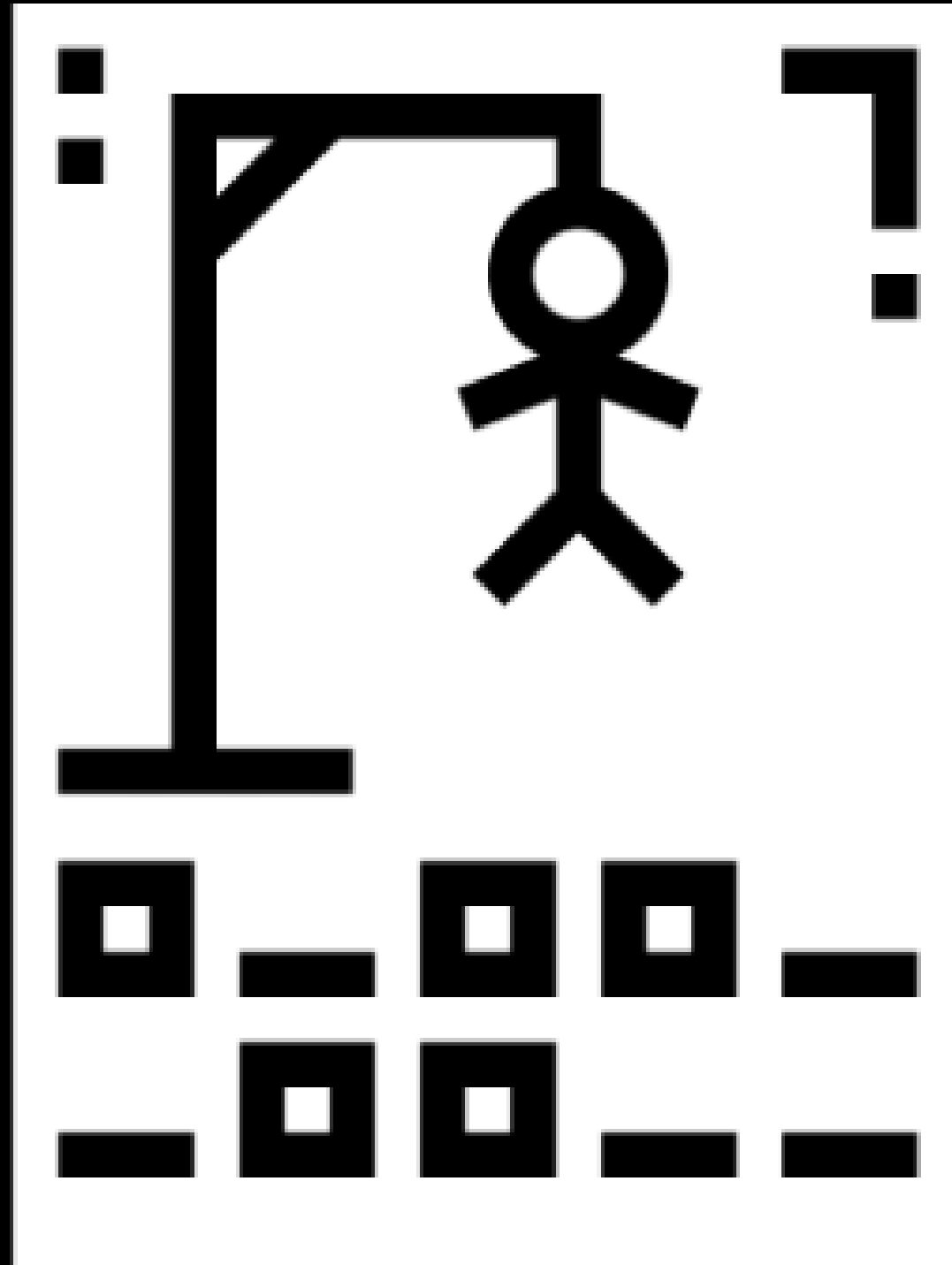
What is the most appropriate management?

If you answered b. plain XR....

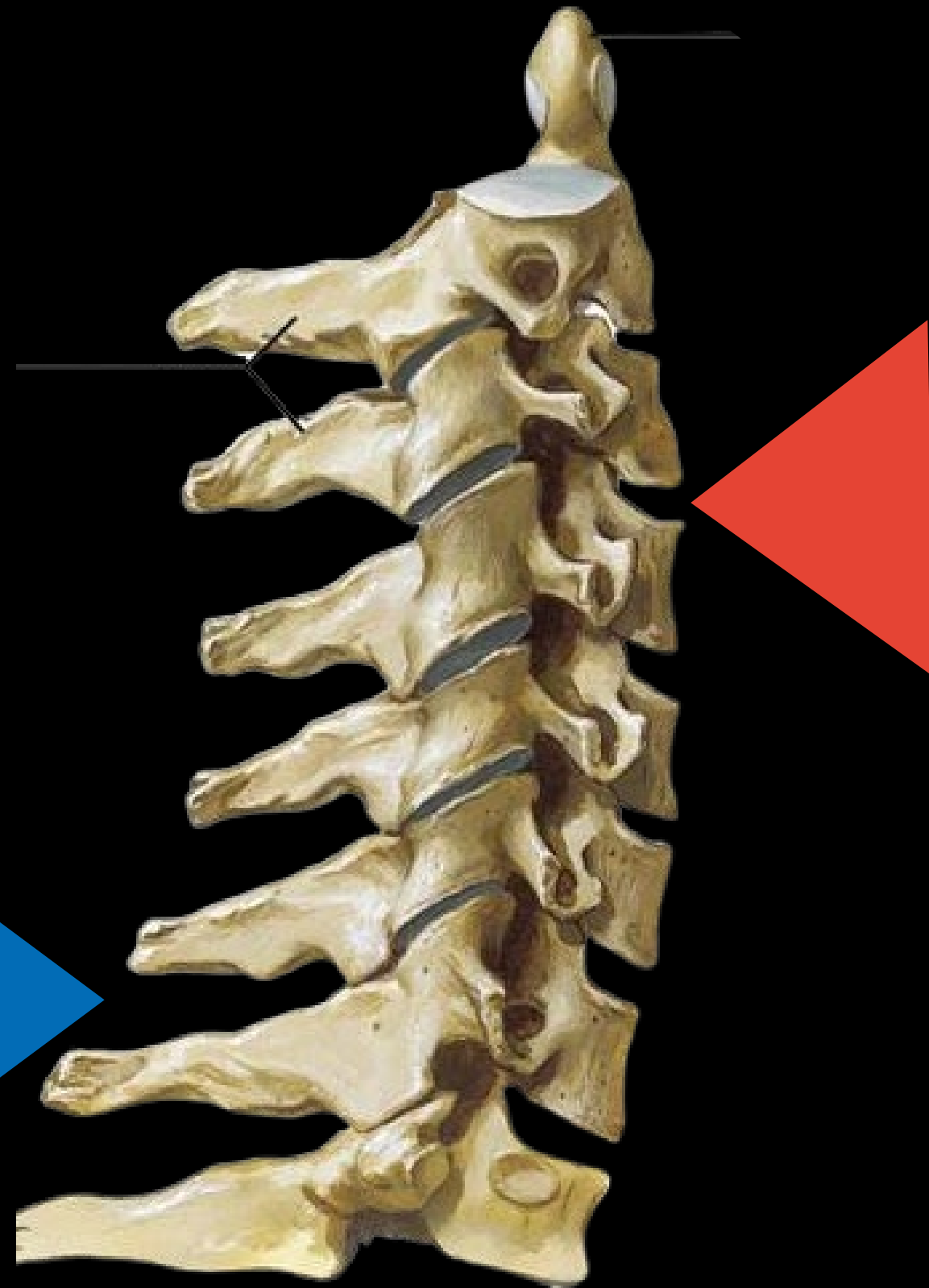
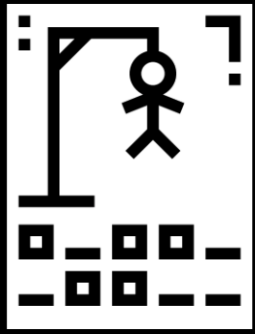


If you answered a, c, d...



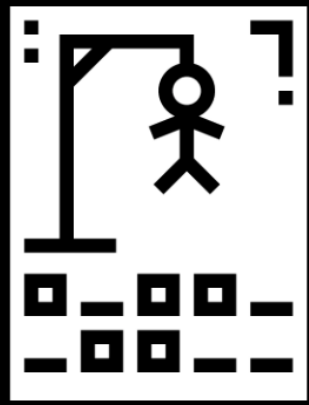


Anatomical Differences



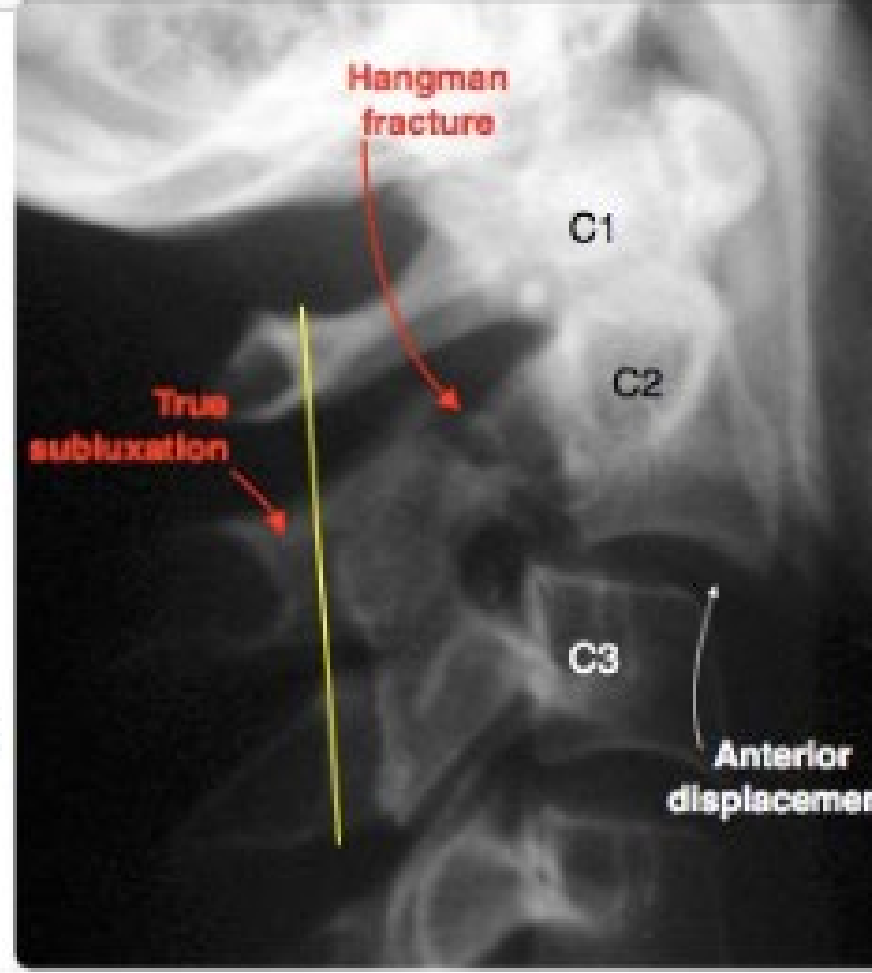
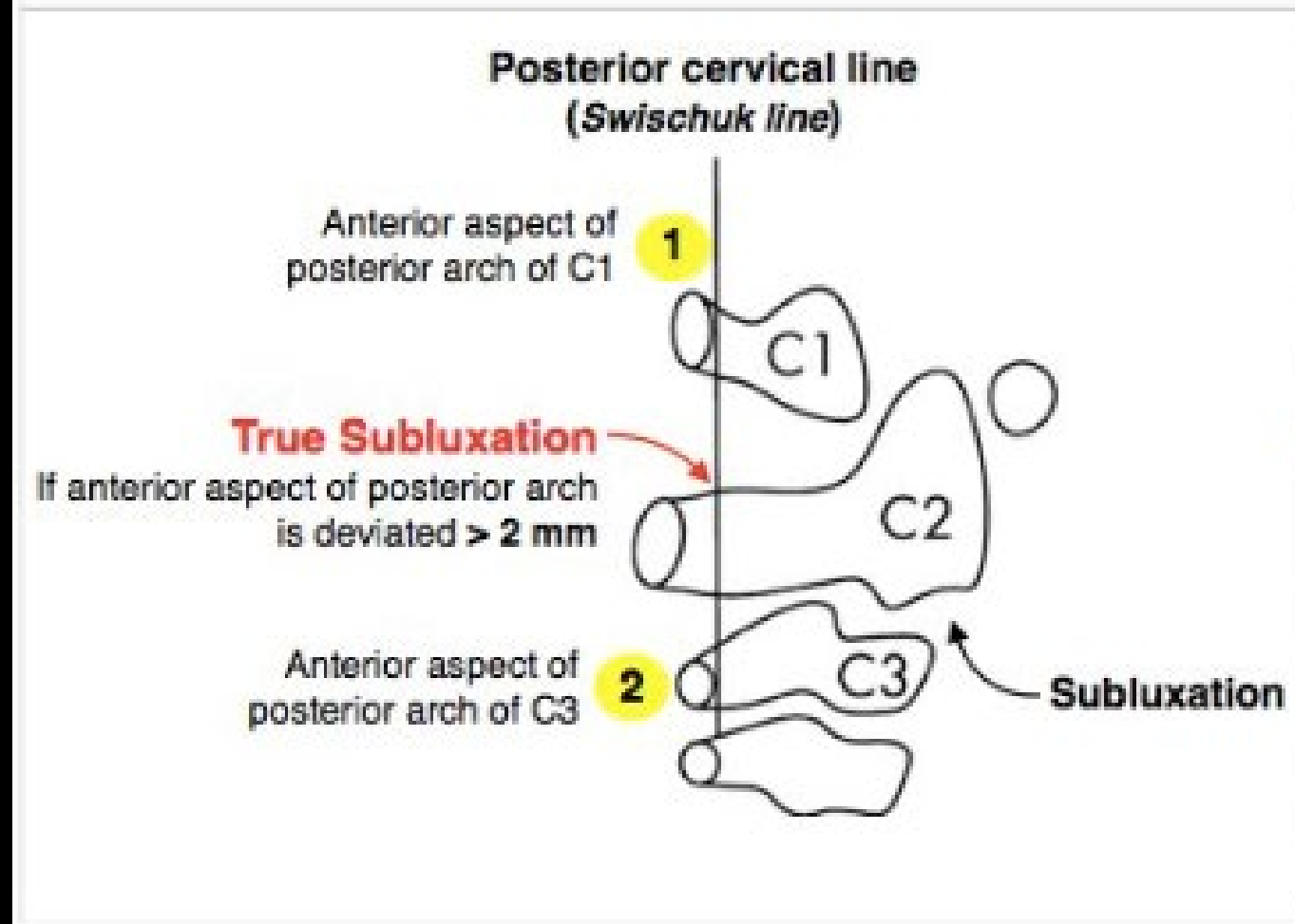
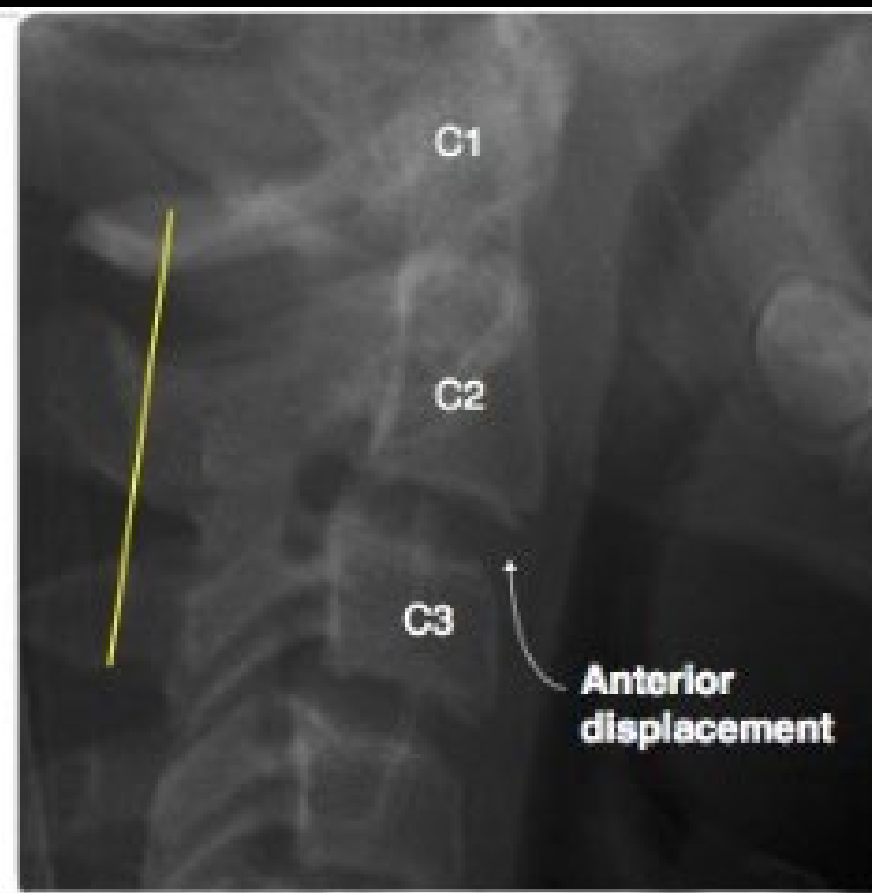
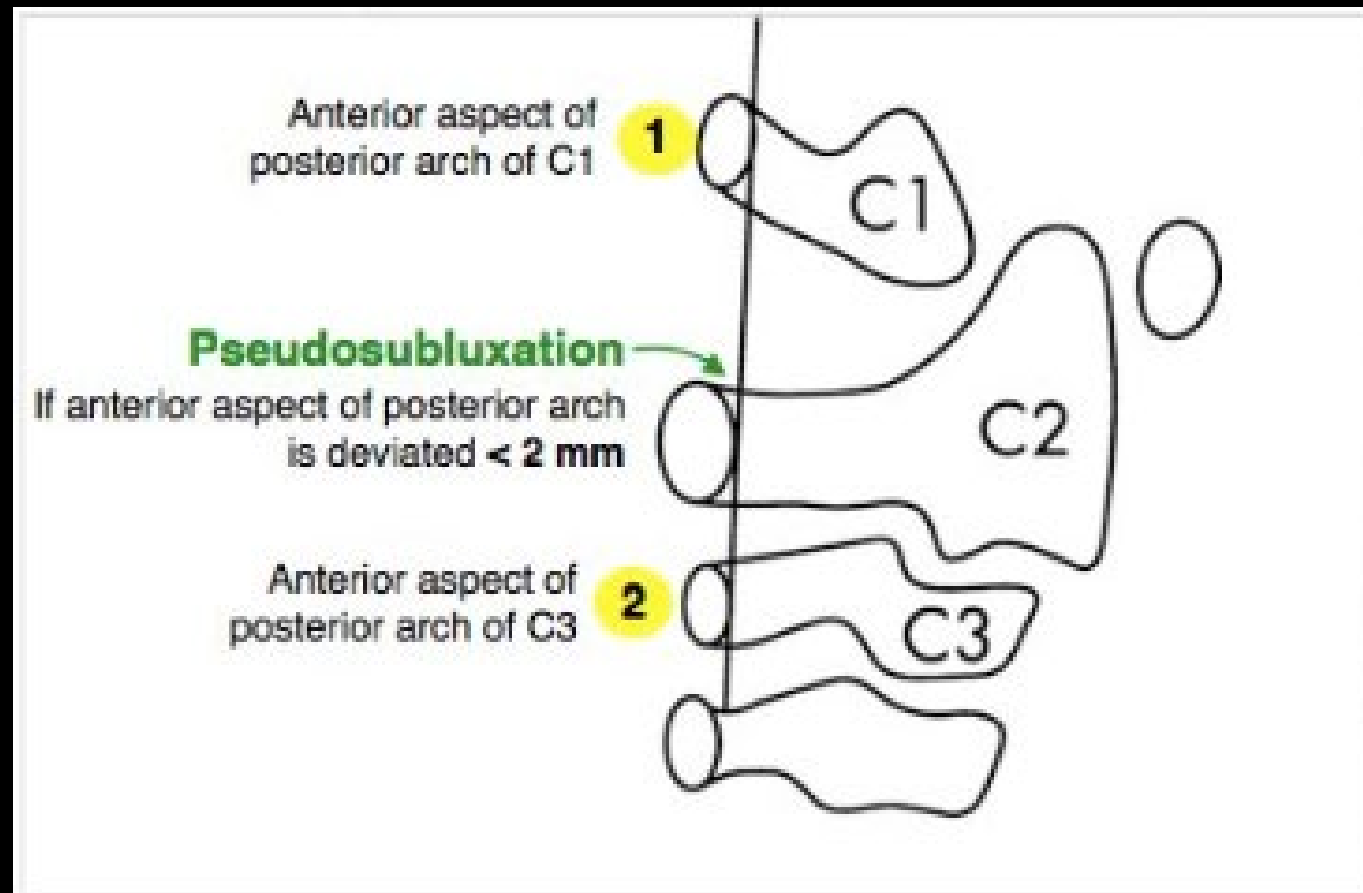
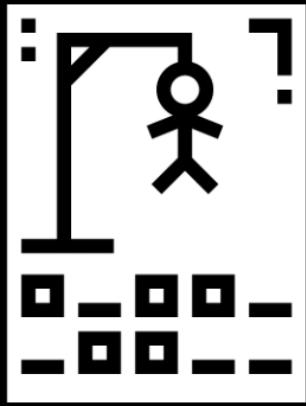
Under 8 yo
- Fulcrum C2-C3
- High CSI

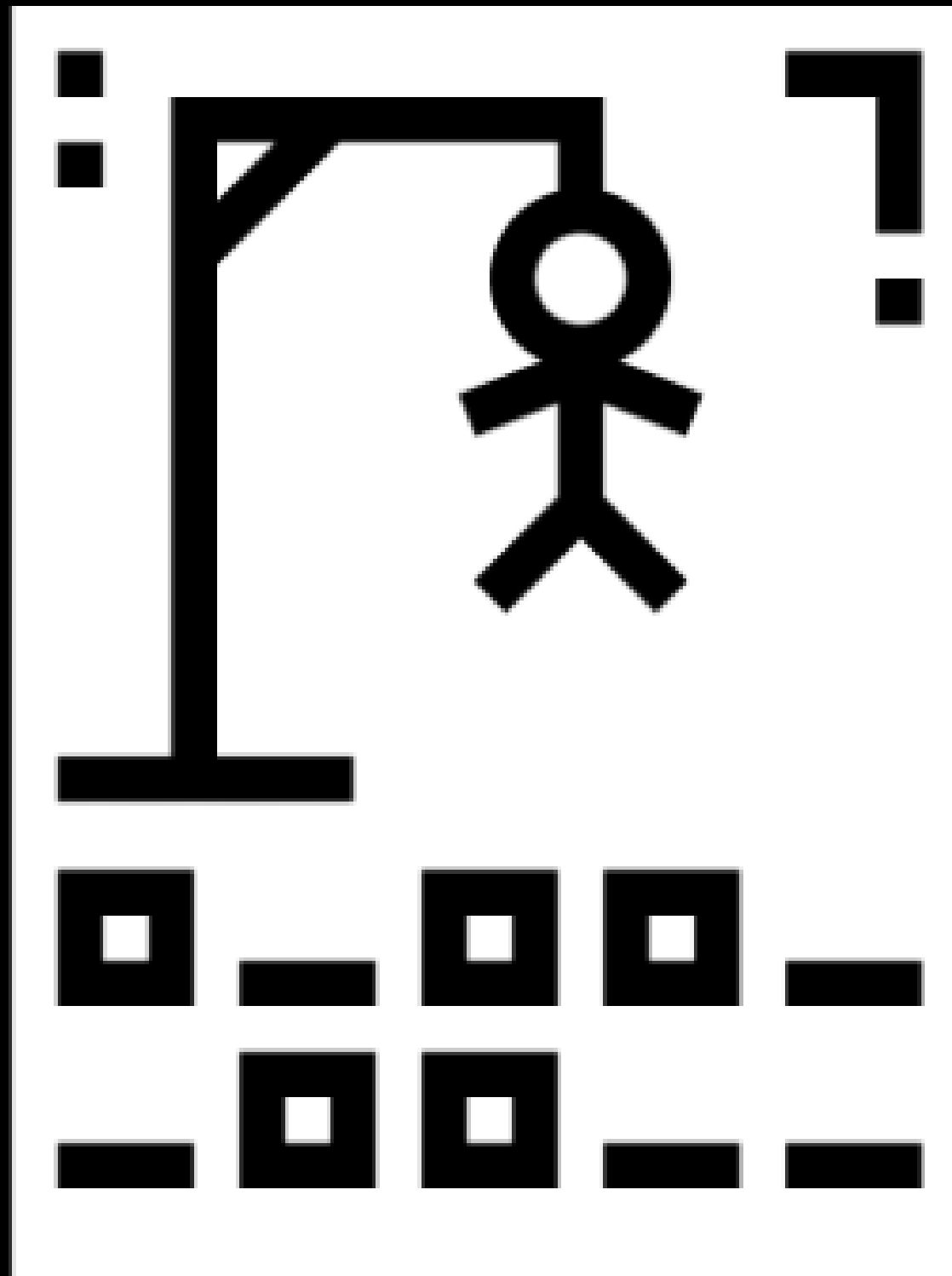
Over 8yo
- Fulcrum C5-C6
- Low CSI



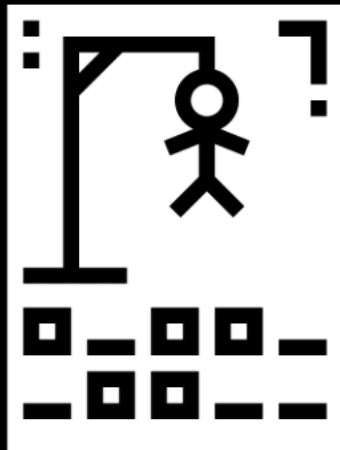
Spinal Cord Injury w/out Radiographic Abnormality
(SCIWORA)

- Cervical Spine stretches 2 inches





Who to Image?



The Canadian C-Spine Rule

Please check off all choices within applicable boxes:

1. Any One High-Risk Factor Which Mandates Immobilization?

- | No | Yes | |
|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | Age \geq 65 years |
| | | OR |
| <input type="checkbox"/> | <input type="checkbox"/> | Dangerous mechanism * |
| | | OR |
| <input type="checkbox"/> | <input type="checkbox"/> | Numbness or tingling in extremities |

Yes

No

2. Any One Low-Risk Factor Which Allows Safe Assessment of Range of Motion?

- | No | Yes | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Simple rearend MVC ** |
| | | OR |
| <input type="checkbox"/> | <input type="checkbox"/> | Ambulatory at any time at scene |
| | | OR |
| <input type="checkbox"/> | <input type="checkbox"/> | No neck pain at scene when asked
(answer "yes" if no pain) |
| | | OR |
| <input type="checkbox"/> | <input type="checkbox"/> | No pain during midline c-spine palpation
(answer "yes" if no pain) |

No

C-Spine
Immobilization

Yes

Unable

3. Patient Voluntarily Able to Actively Rotate Neck 45°
Left and Right When Requested, Regardless of Pain?

- | No | Yes |
|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> |

Able

No C-Spine
Immobilization ***

* Dangerous Mechanism

- fall from elevation \geq 3feet/5 stairs
- axial load to head, e.g. diving
- MVC high speed (\geq 100km/hr), rollover, ejection
- motorized recreational vehicles e.g. ATV
- bicycle collision with object e.g. post, car

** Simple Rearend MVC Excludes:

- pushed into oncoming traffic
- hit by bus/large truck
- rollover
- hit by high speed vehicle (\geq 100 km/hr)

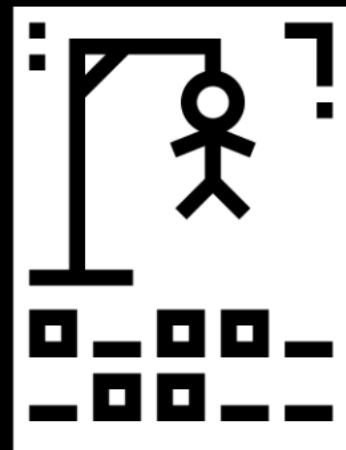


Figure 11. National Emergency X-Radiography Utilization Study (NEXUS) Criteria

Meets all low-risk criteria?

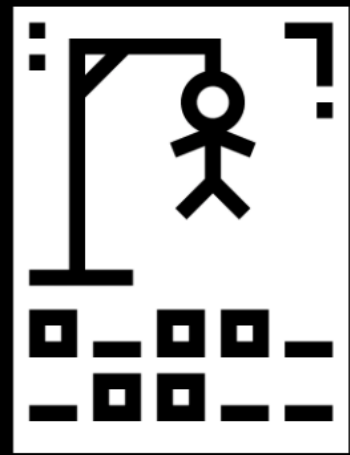
1. No posterior midline cervical-spine tenderness
2. No evidence of intoxication
3. A normal level of alertness
4. No focal neurologic deficit
5. No painful distracting injuries

YES

No Radiography

NO

Radiography



High Risk Criteria for <8

Preexisting Conditions

Neuro Exam

High Risk Injury

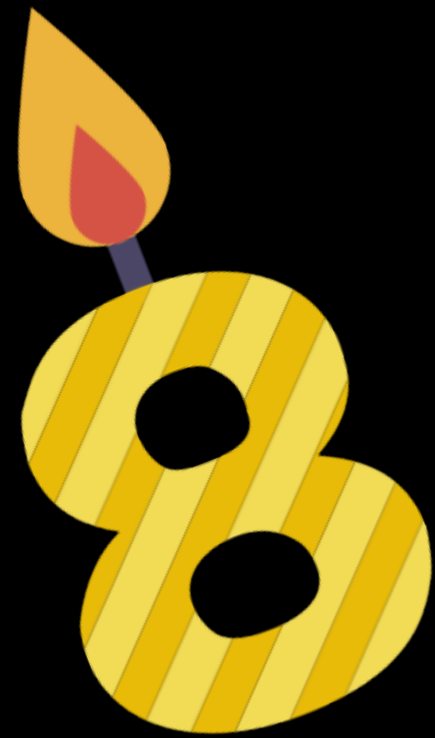
CerVical Neck Pain

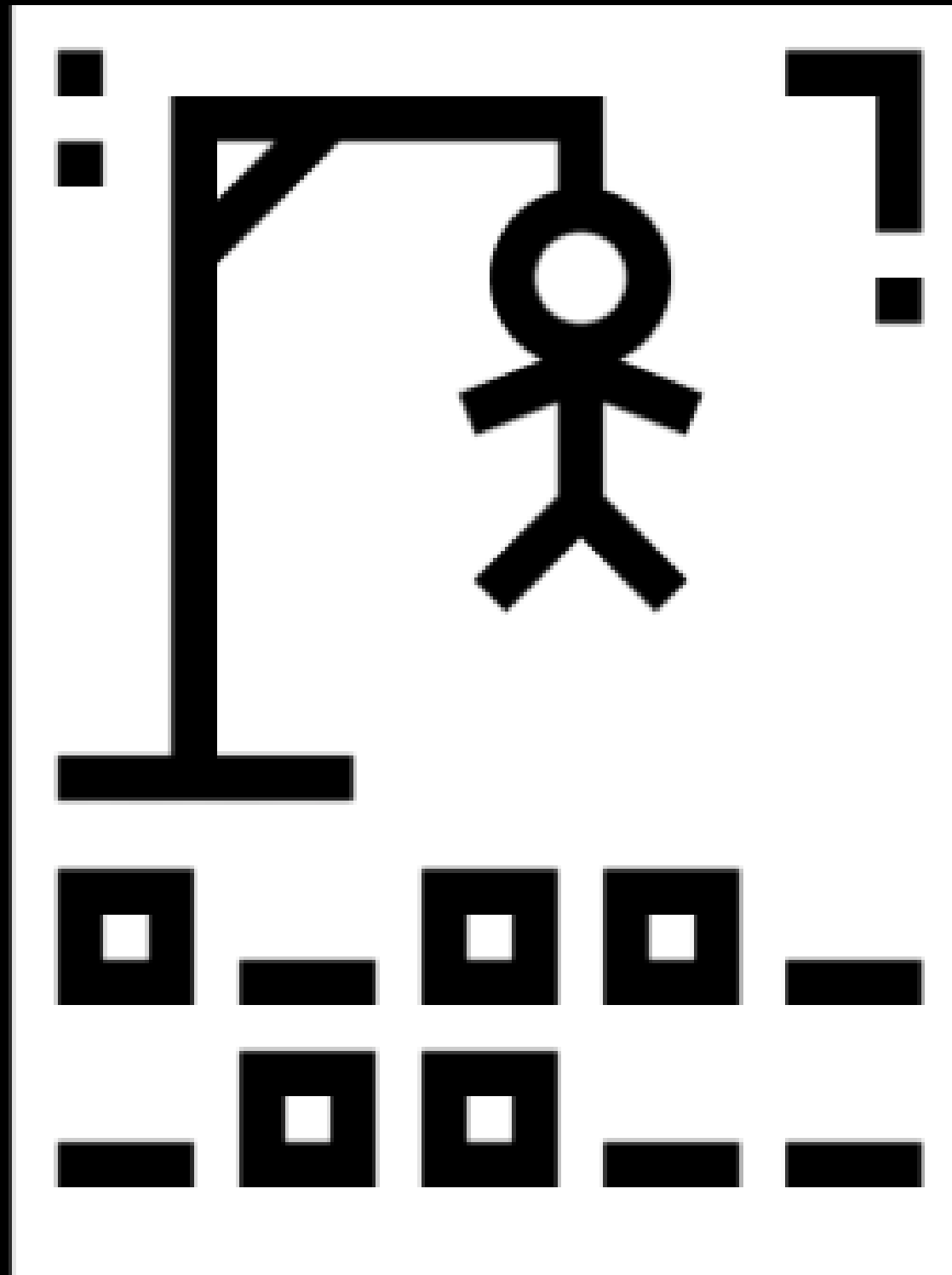
Distracting Injury

Crick (Torticollis)

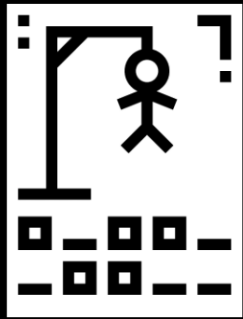
AMS or Age

Limited ROM



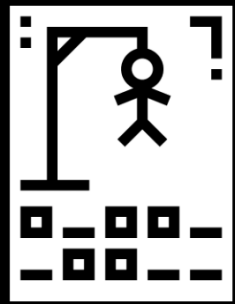


How to Image?



Xray Imaging:

- AP, Lateral
- Odontoid if >9yo
- Flexion/extension view not helpful



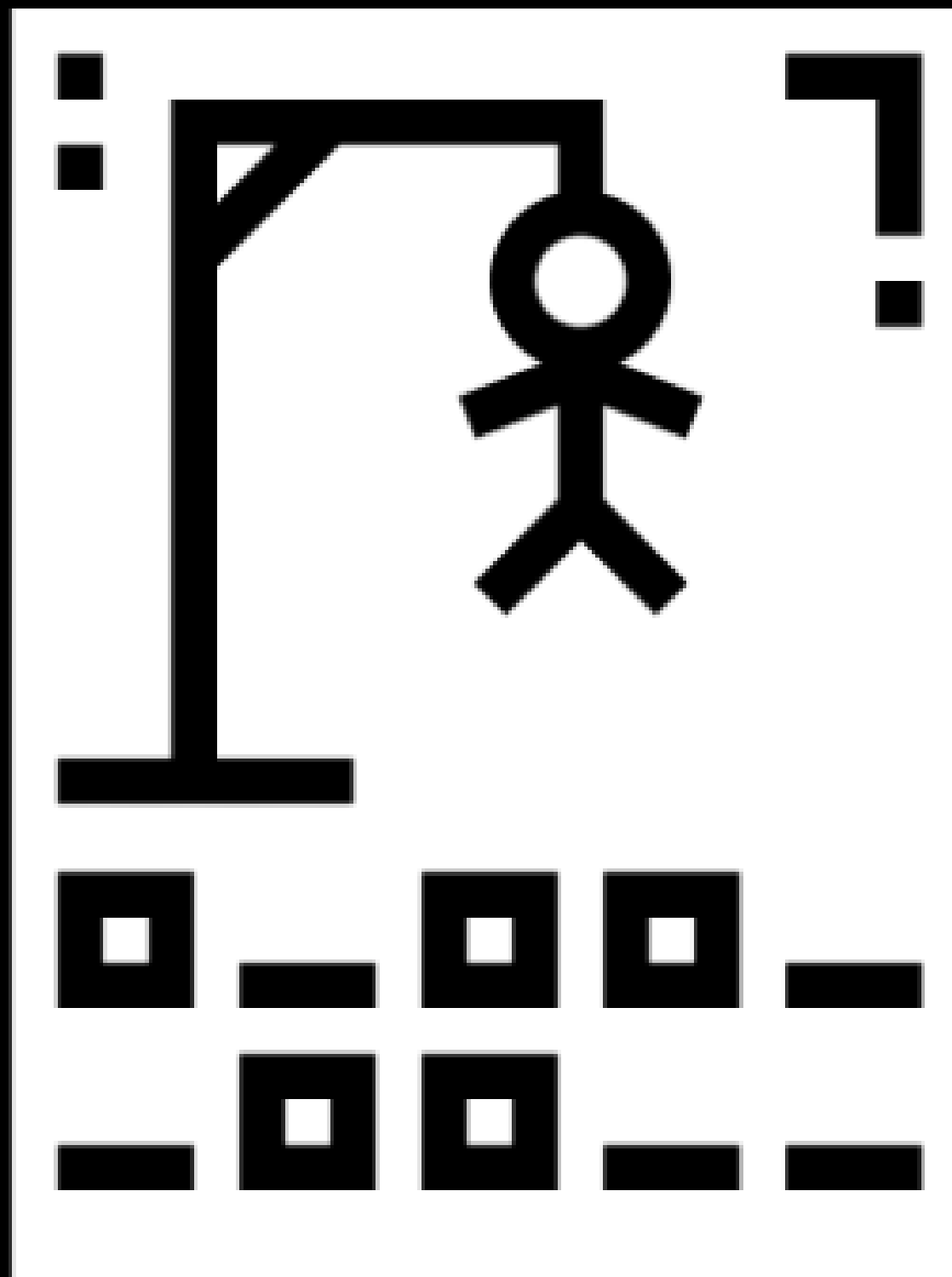
CT Imaging:

- Abnormal Xrays
- Obtunded patients
- CT Head + C1-3 Protocol for <8yo

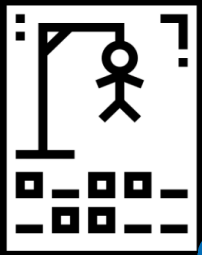


MRI Imaging:

- Abnormal Xrays/CT
- Obtunded patients
- Neuro Sx (SCIWORA)



Suggested Algorithm



<8yo
Imaging Indicated
High Risk criteria?

Yes

>8yo
Imaging Indicated by NEXUS?

XR Normal
Physical Exam



XR Abnormal
Spine Consult
CT Cervical Spine or MRI

Normal
Discharge

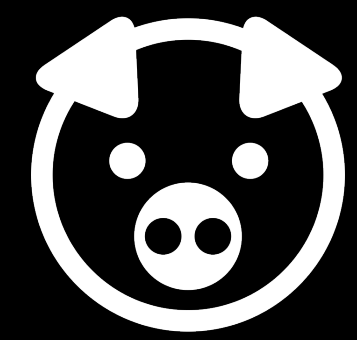
Ortho Symptoms
Spine Consult
CT Cervical Spine or MRI

Neuro Symptoms
Neurosurgery Consult
MRI for SCIWORA

Obtunded
Admission
MRI v CT



Thoracic Pearls



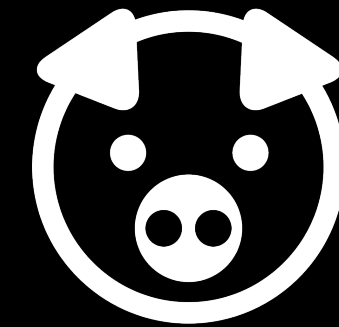
When evaluating a child with blunt chest trauma, which of the following is the best indicator to perform a chest CT scan to rule out a thoracic vascular injury?

- a. First rib fracture
- b. Strong radial pulse
- c. Pulmonary contusion
- d. Mediastinal abnormality on CXR



When evaluating a child with blunt chest trauma, which of the following is the best indicator to perform a chest CT scan to rule out a thoracic vascular injury?

If you answered a. first rib fracture....

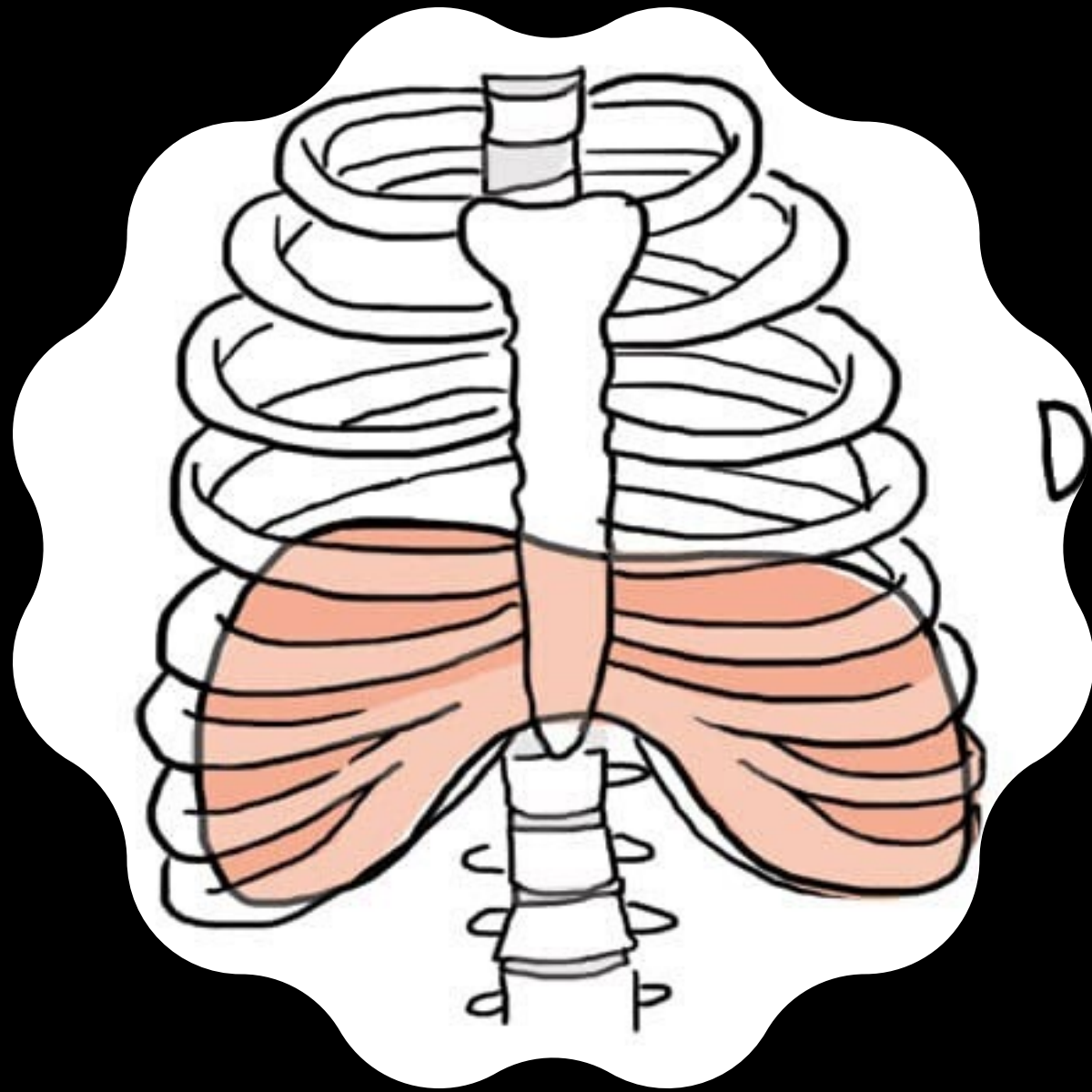
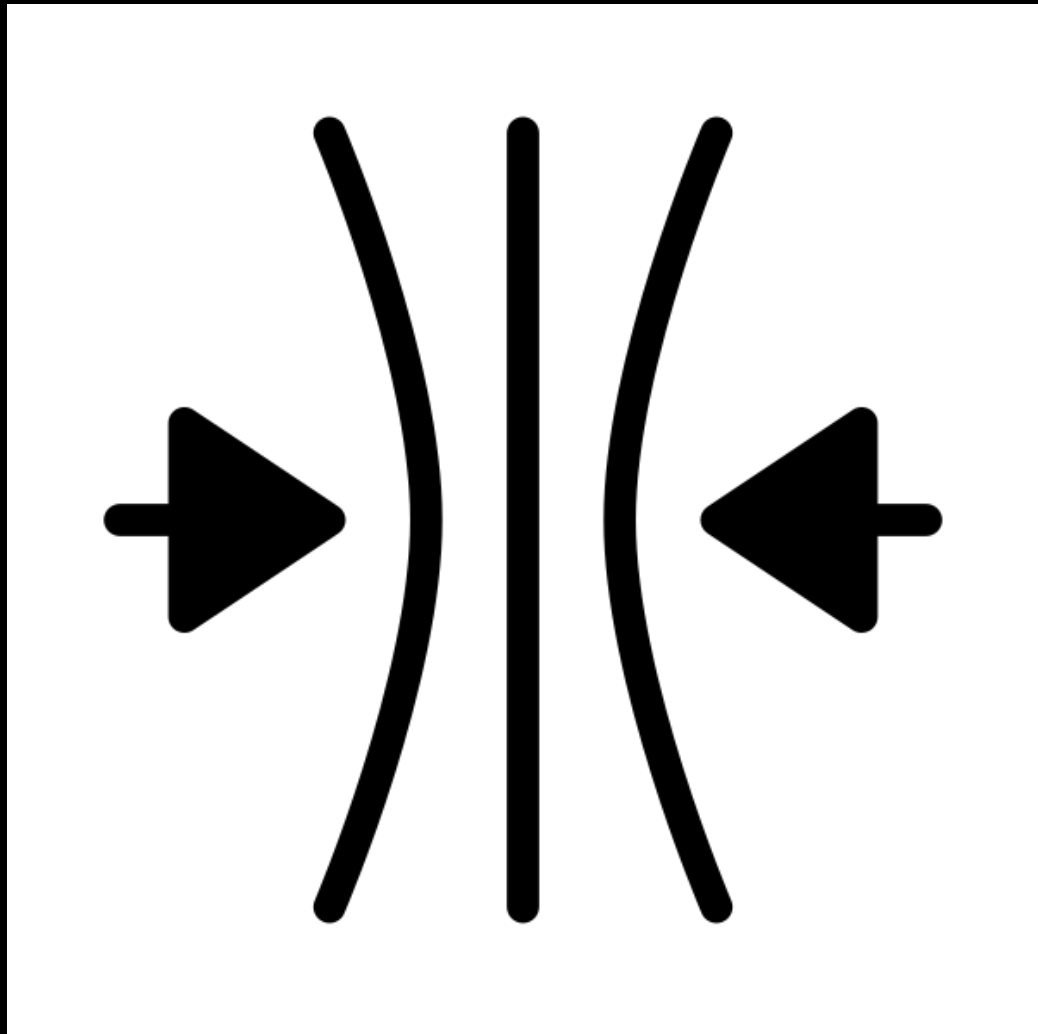


If you answered b, c, d...





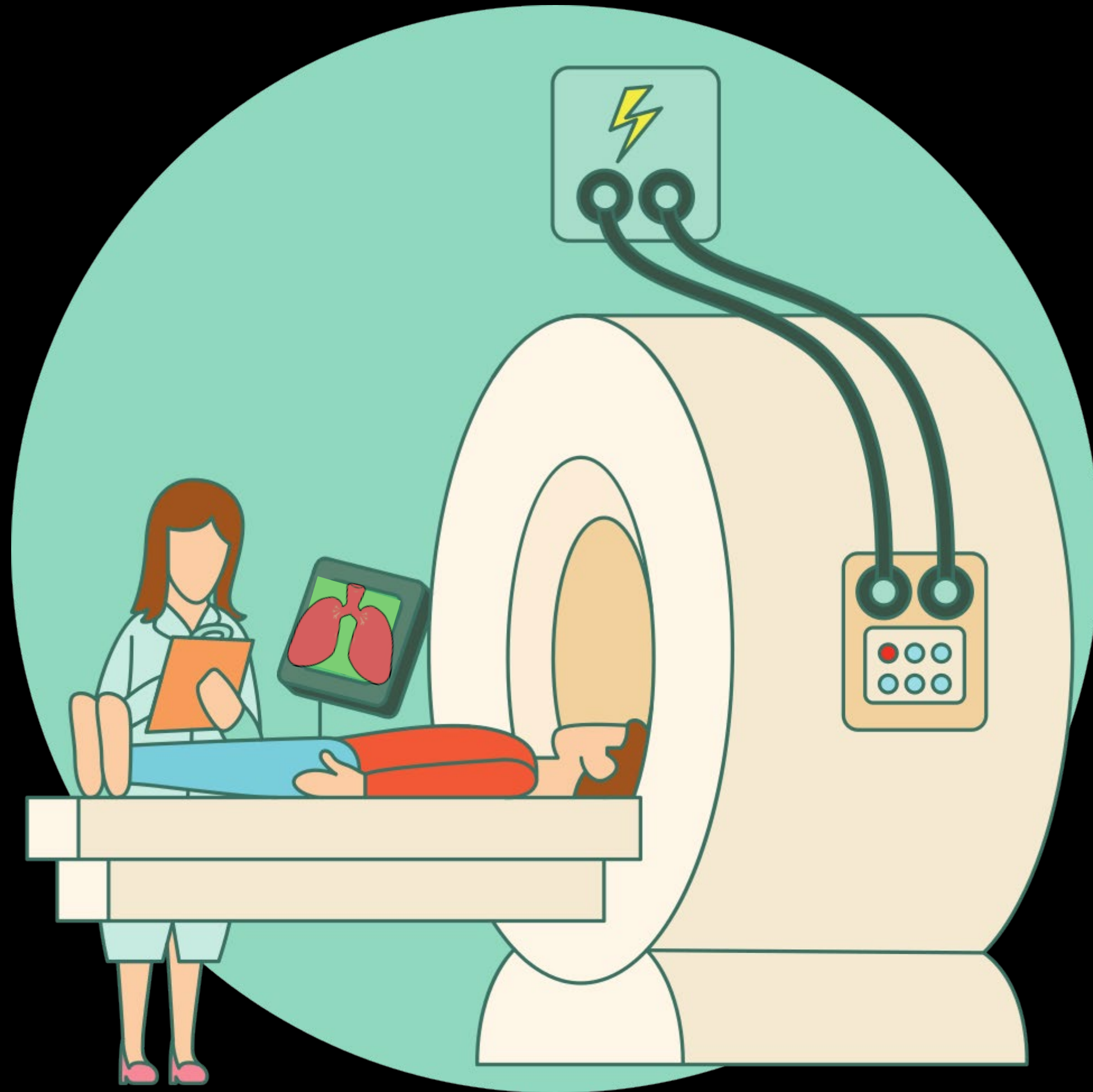
Anatomic Differences





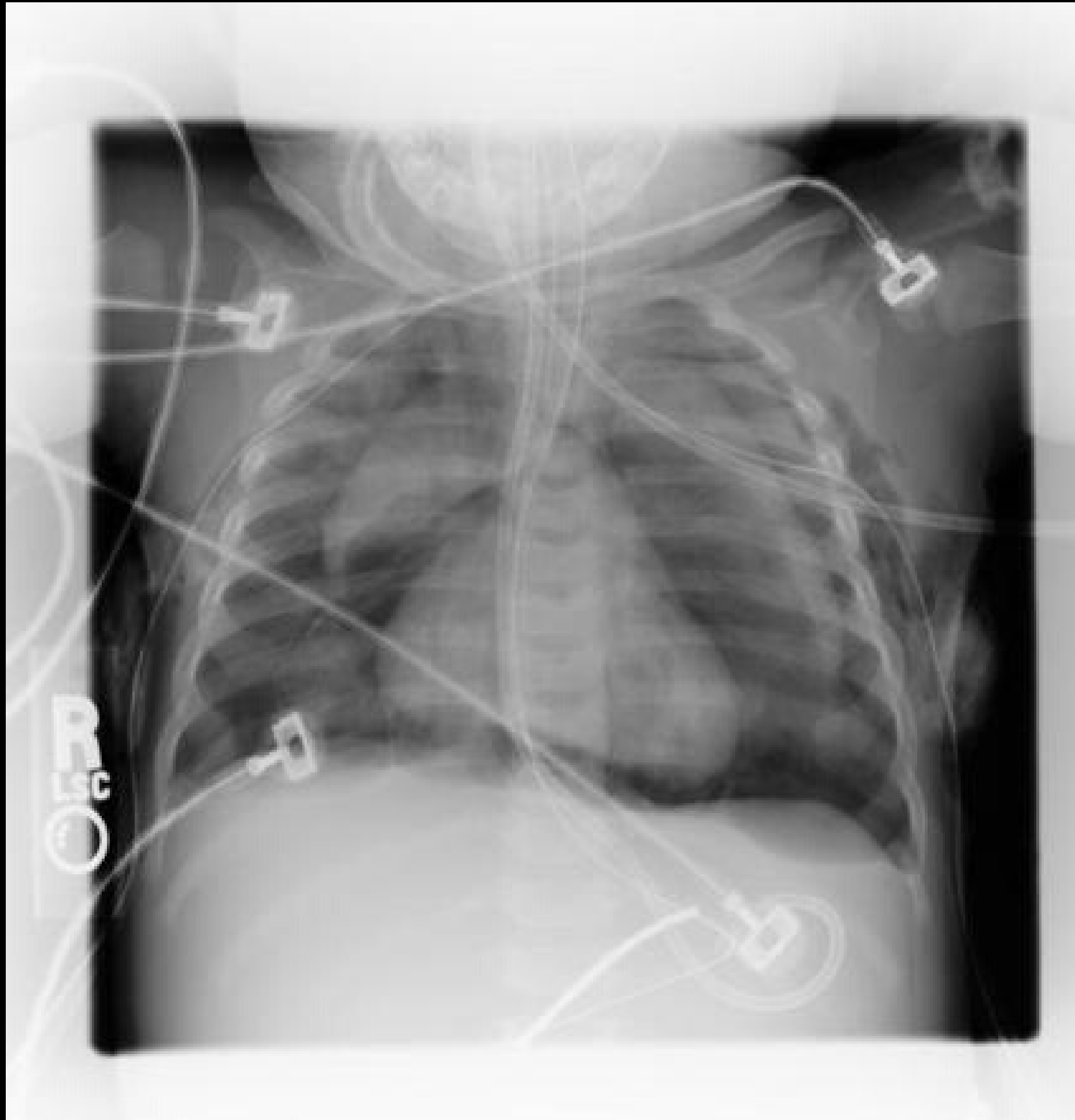
When to Image?



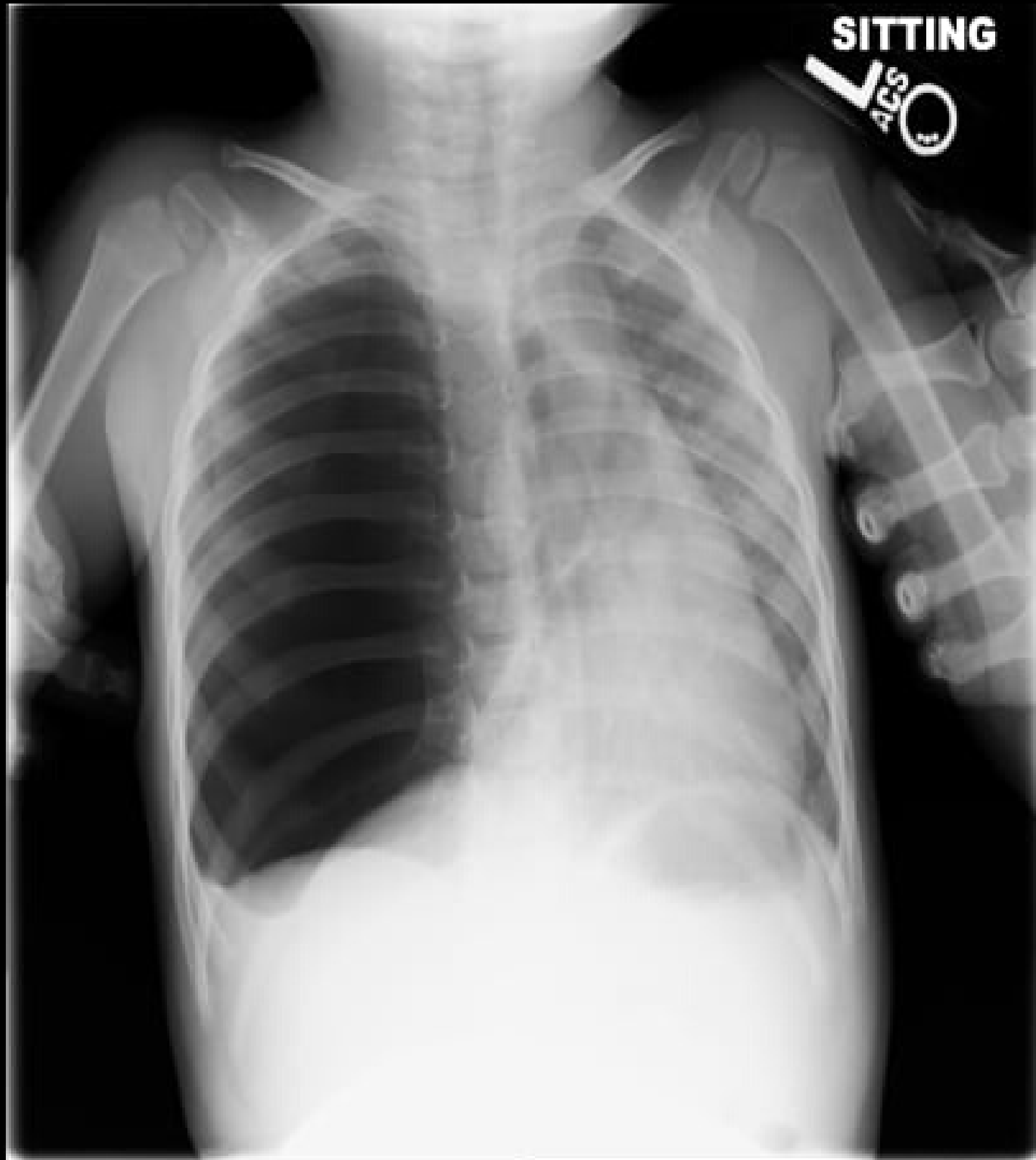




Management



Spinnaker Sign
- Esophageal Injury



Uncuffed ETT

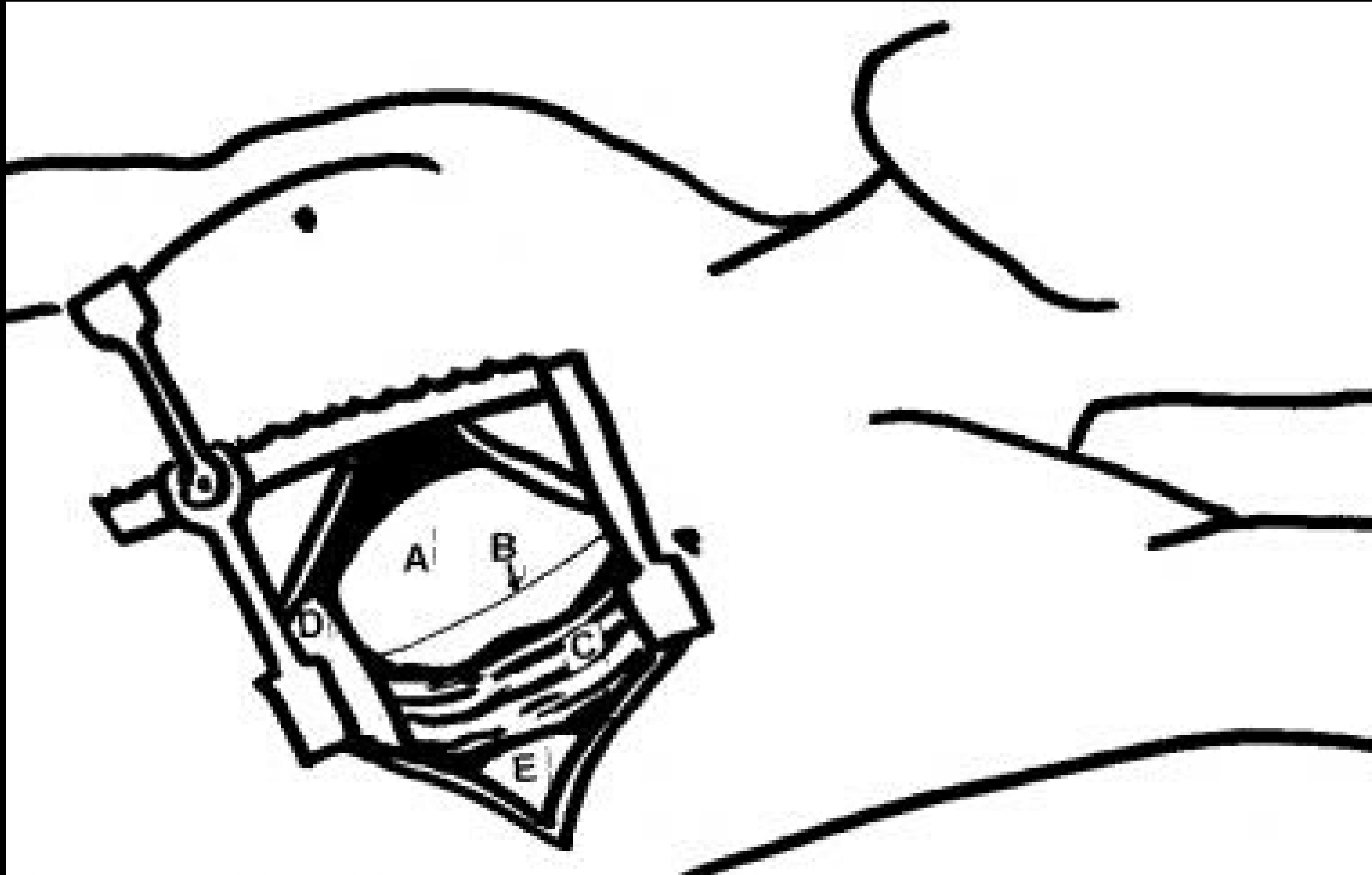
$$= \text{Age}/4 + 4$$

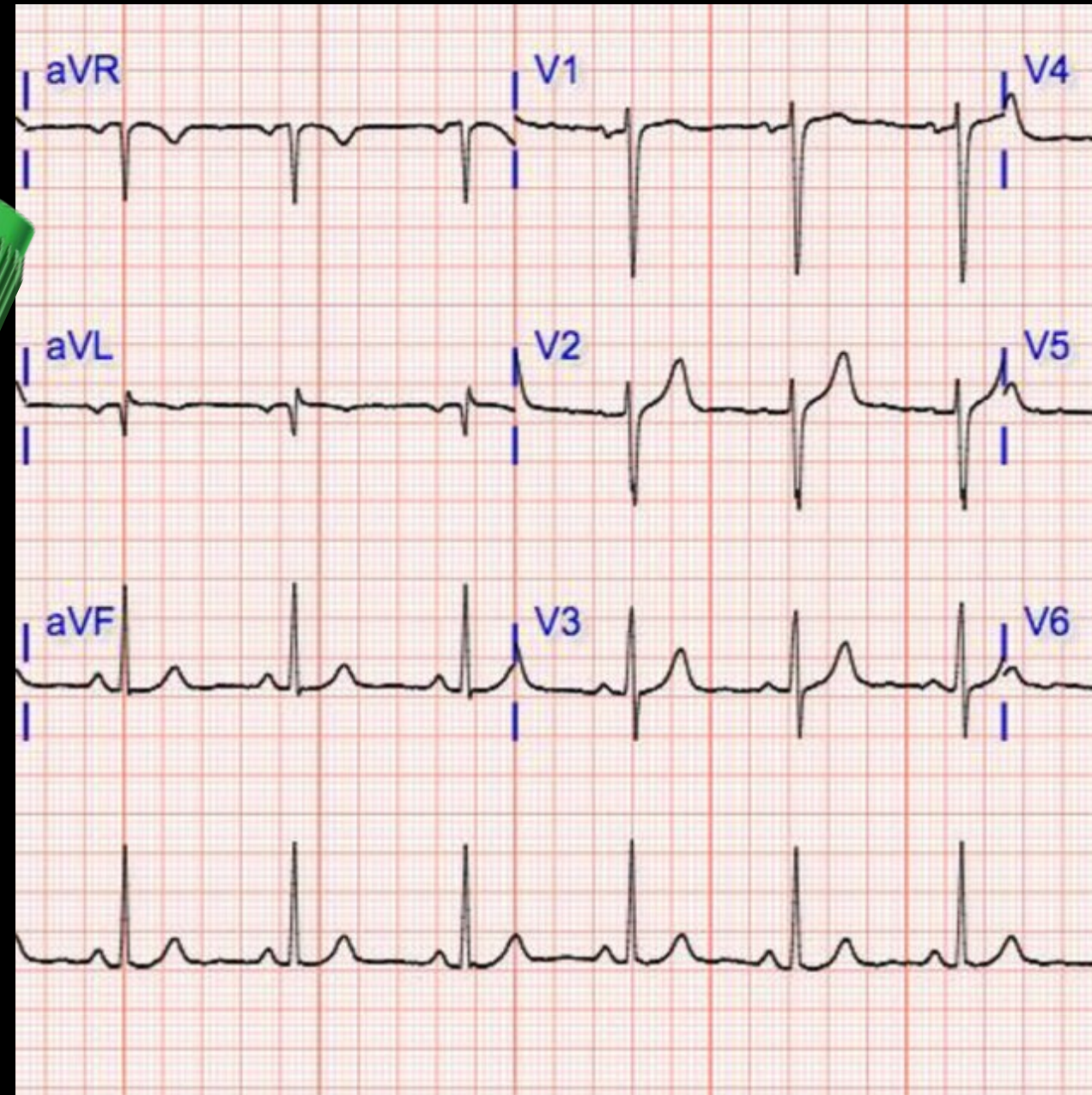


Chest Tube

$$= \text{ETT} \times 4$$



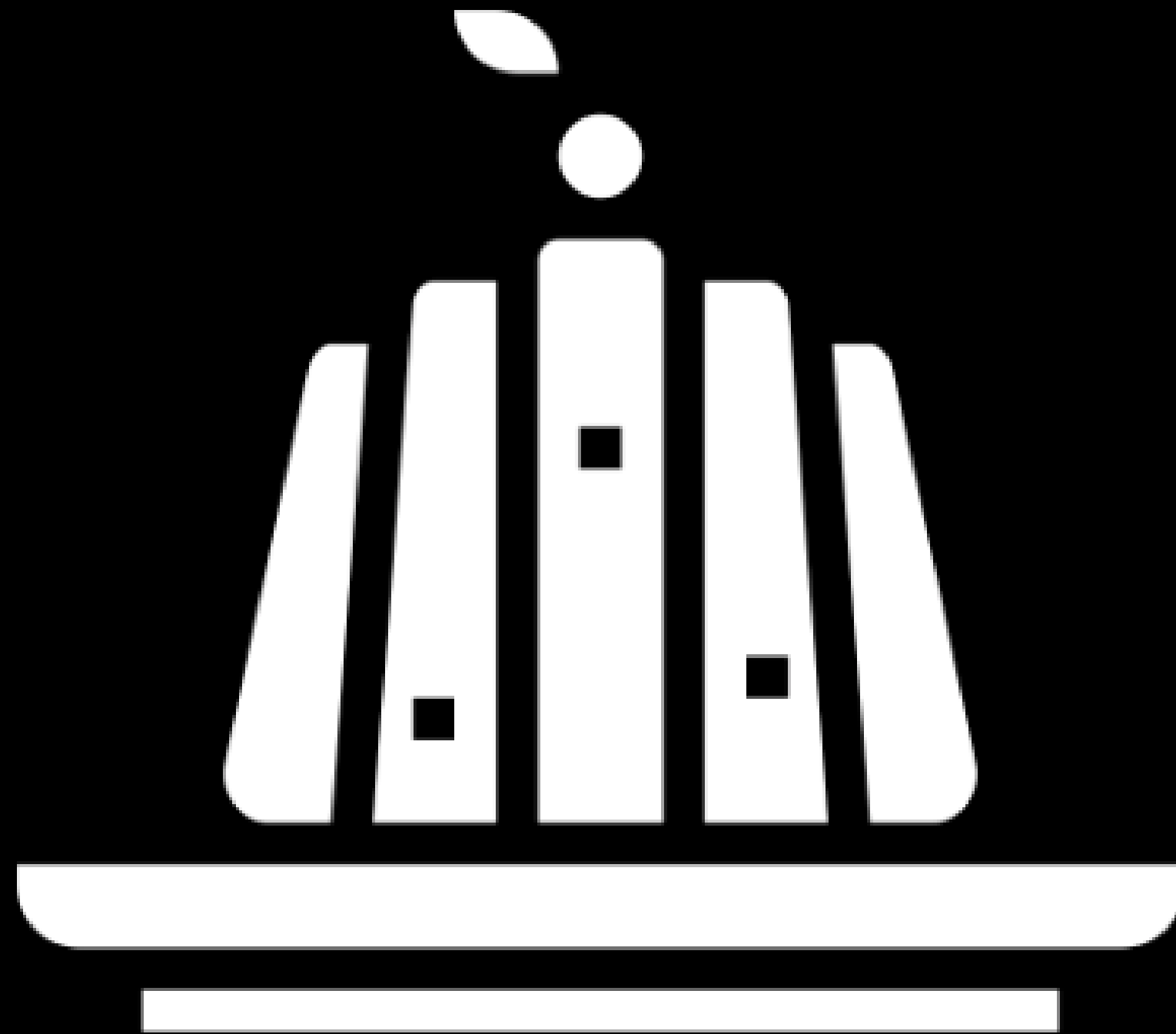




Blunt Cardiac Injury -

ECG

- Troponin



Abdominal Injury



6yo restrained passenger is brought to the ED after high speed MVC. She is noted to have abdominal wall bruising and distention. What injury is most likely to be present?

- a. Cervical Spine Injury
- b. Intra-abdominal Injury
- c. Intracranial Injury
- d. Pulmonary Contusion



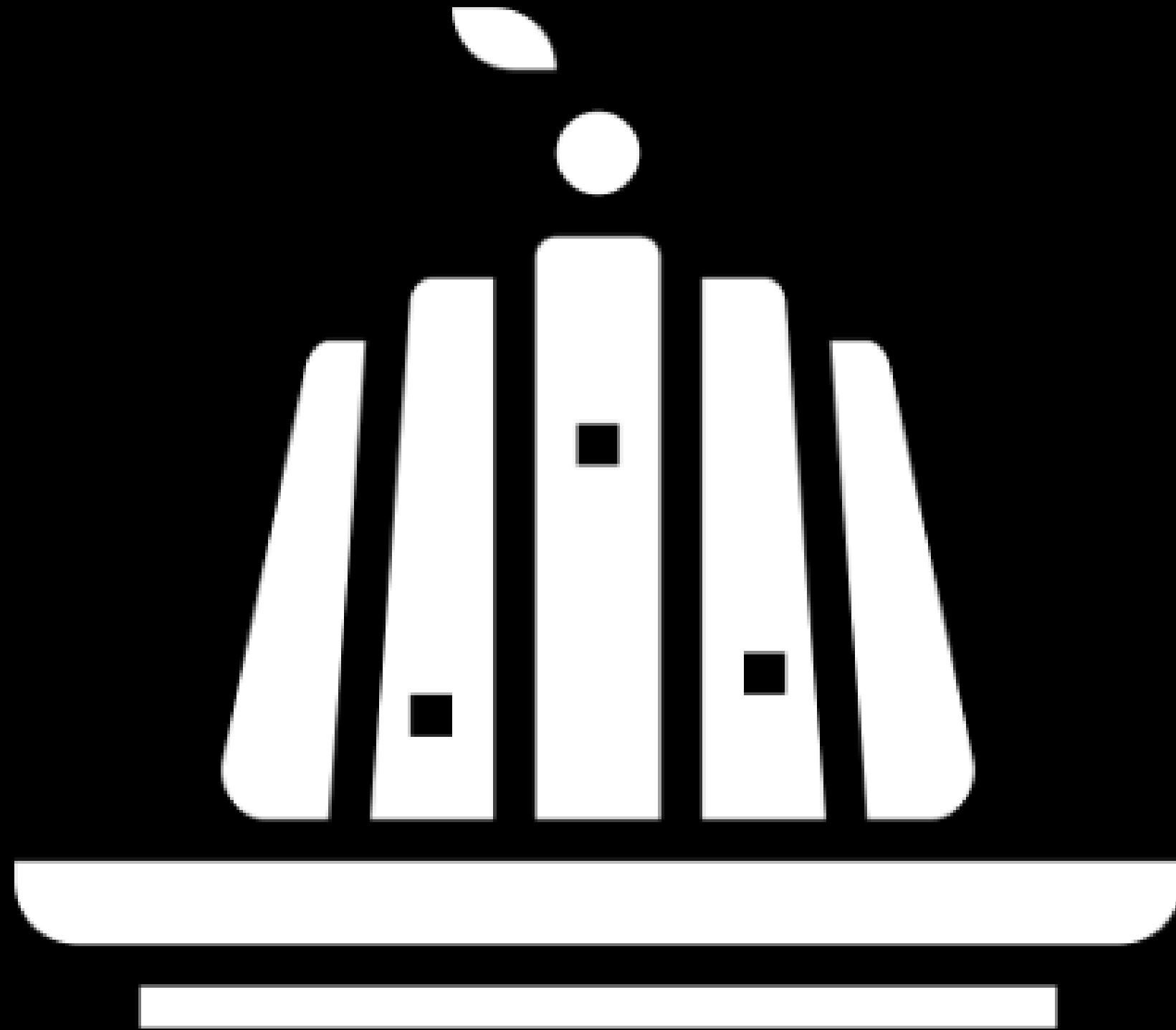
What injury is most likely to be present?

If you answered b. intrabdominal injury ...



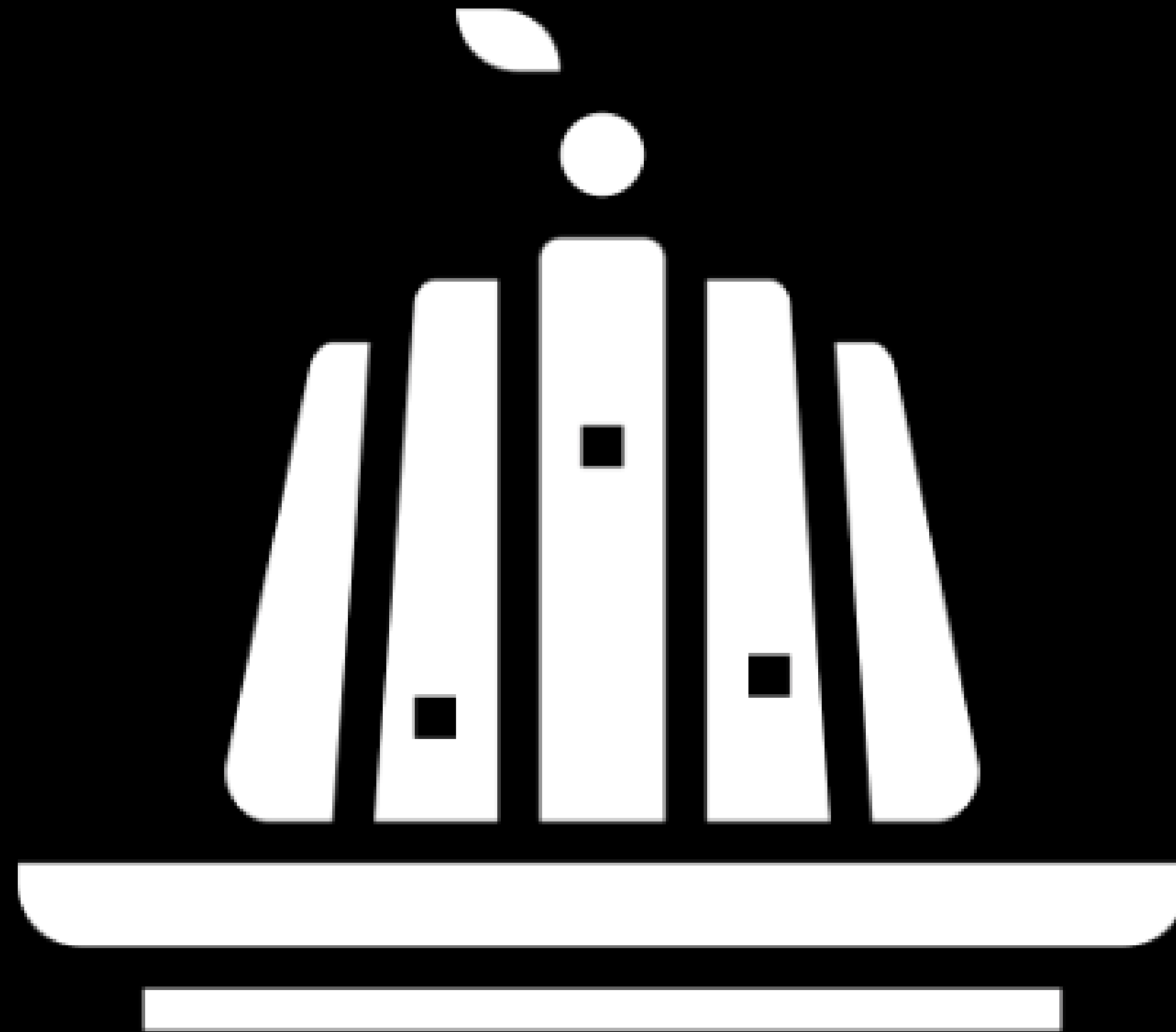
If you answered b, c, d...



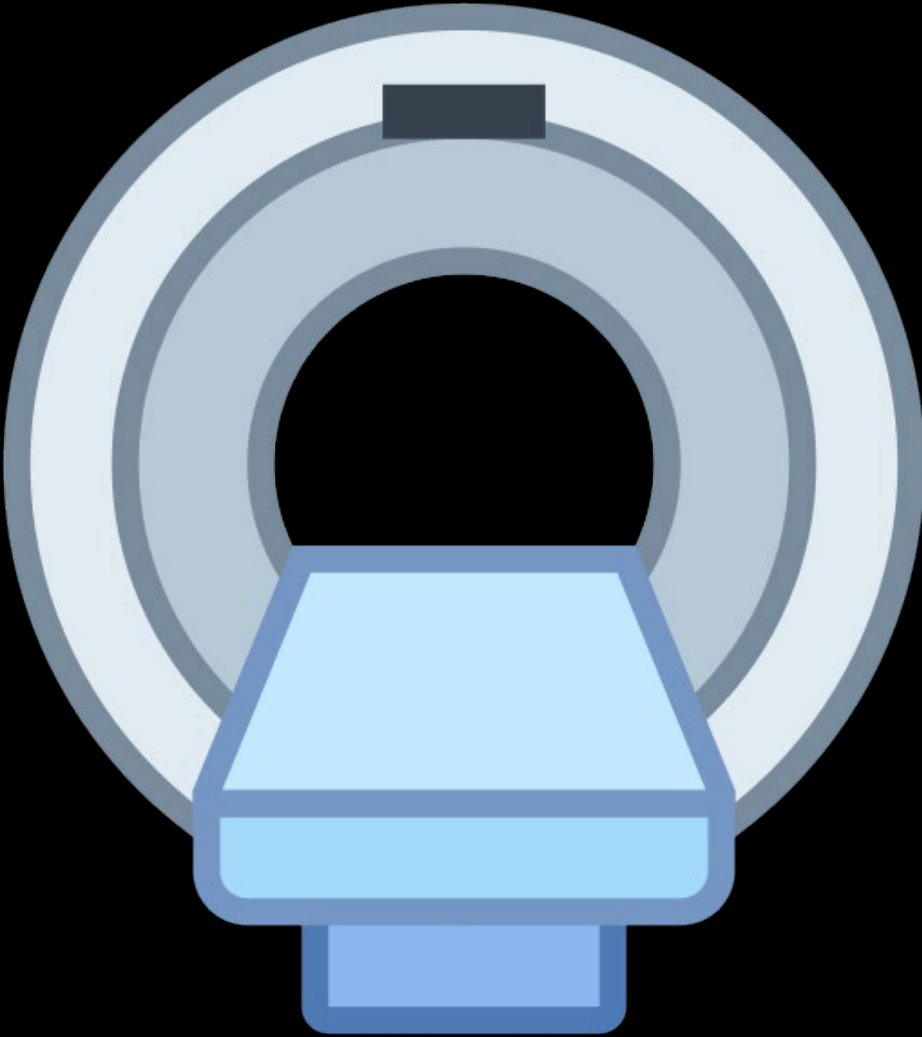


Anatomical Differences





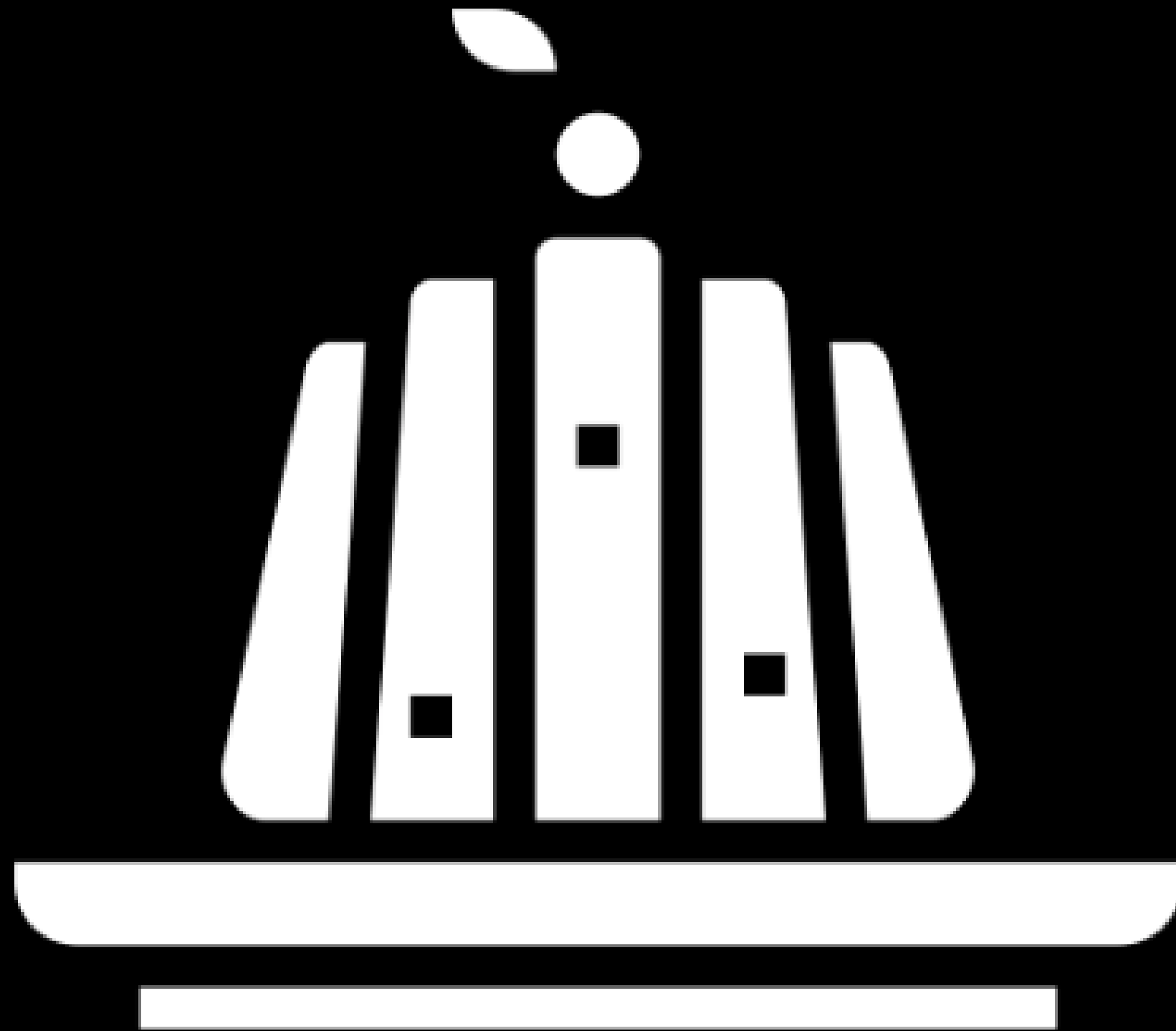
Penetrating Abdominal Trauma



Stable



Unstable



Blunt Abdominal Trauma



PECARN for Abdominal Trauma



Abdominal Wall Bruising

GCS <14

Abdominal Tenderness

Thoracic Trauma

Abdominal Pain

Decreased Breath Sounds

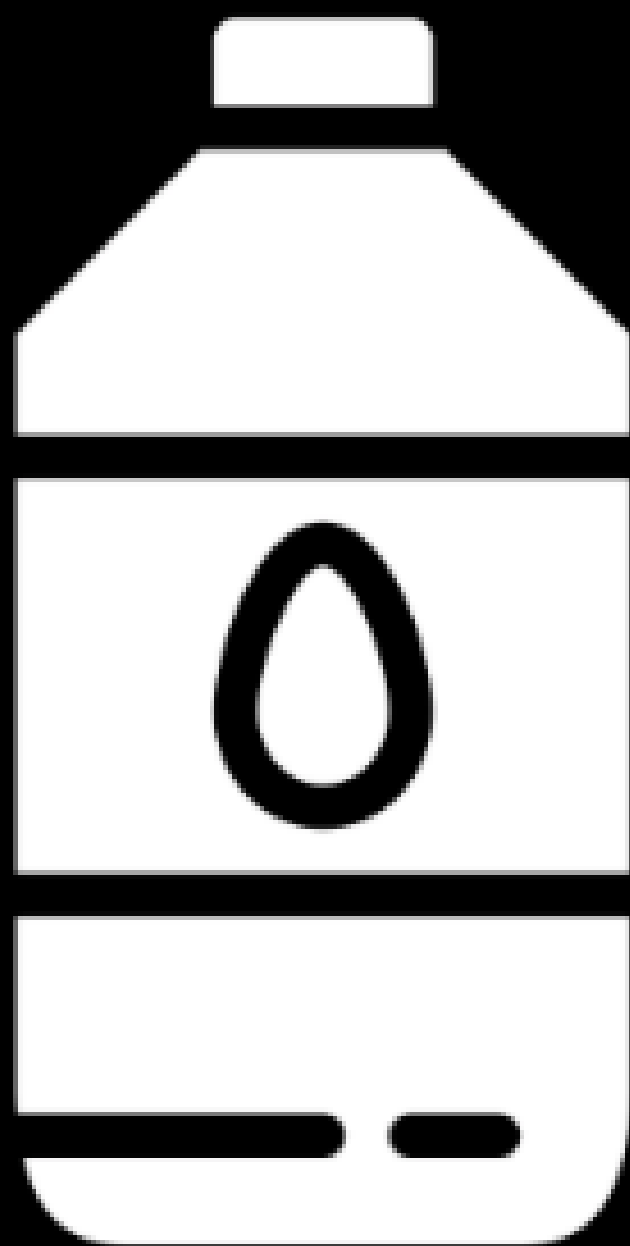
Vomiting



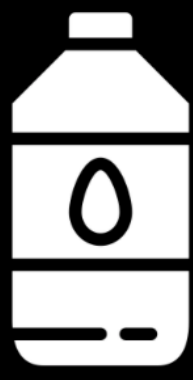
If clinical suspicion is high....
Serial Exams for 12 Hours





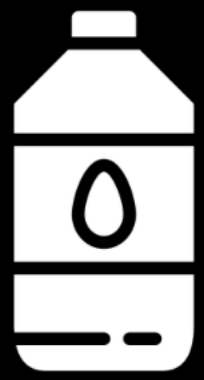


Genitourinary Tract Pearls

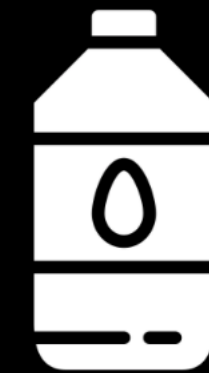


11yo girl is brought to ED after being kicked by a horse. She is alert and cooperative. Her vital signs and exam are normal. UA reveals microscopic hematuria of 50 RBC/HPF. Appropriate evaluation and management should include?

- a. Abdominal Imaging
- b. Discharge and outpatient follow up
- c. FAST examination
- d. Repeat UA in 4 hours



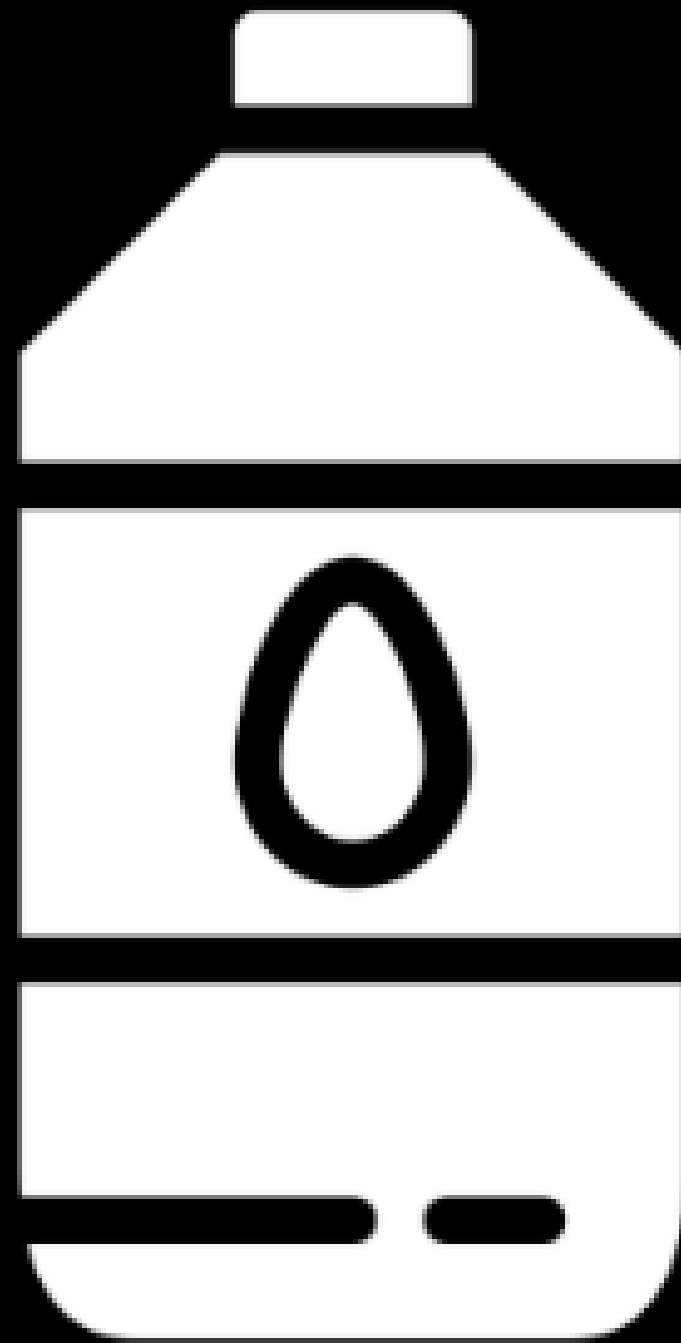
UA reveals microscopic hematuria of 30RBC/HPF.
Appropriate evaluation and management should
include?



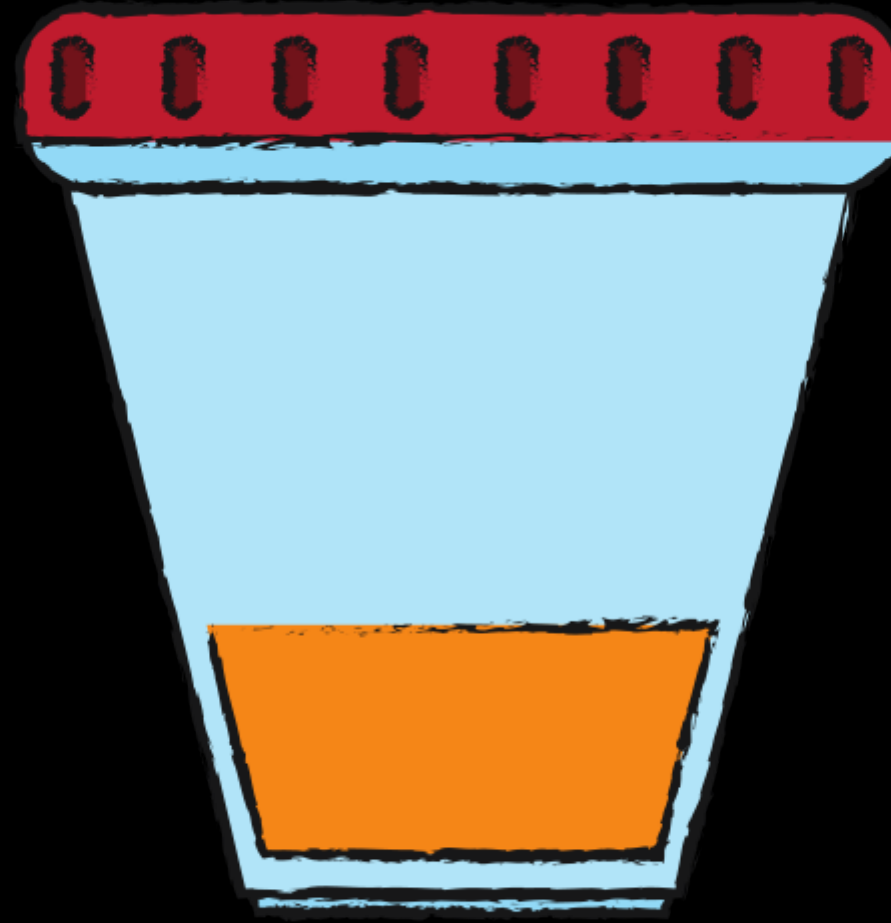
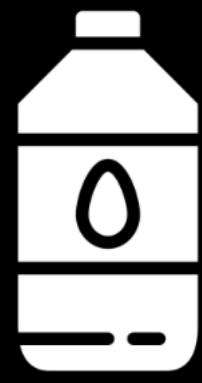
If you answered a. abdominal imaging....

If you answered b, c, d...



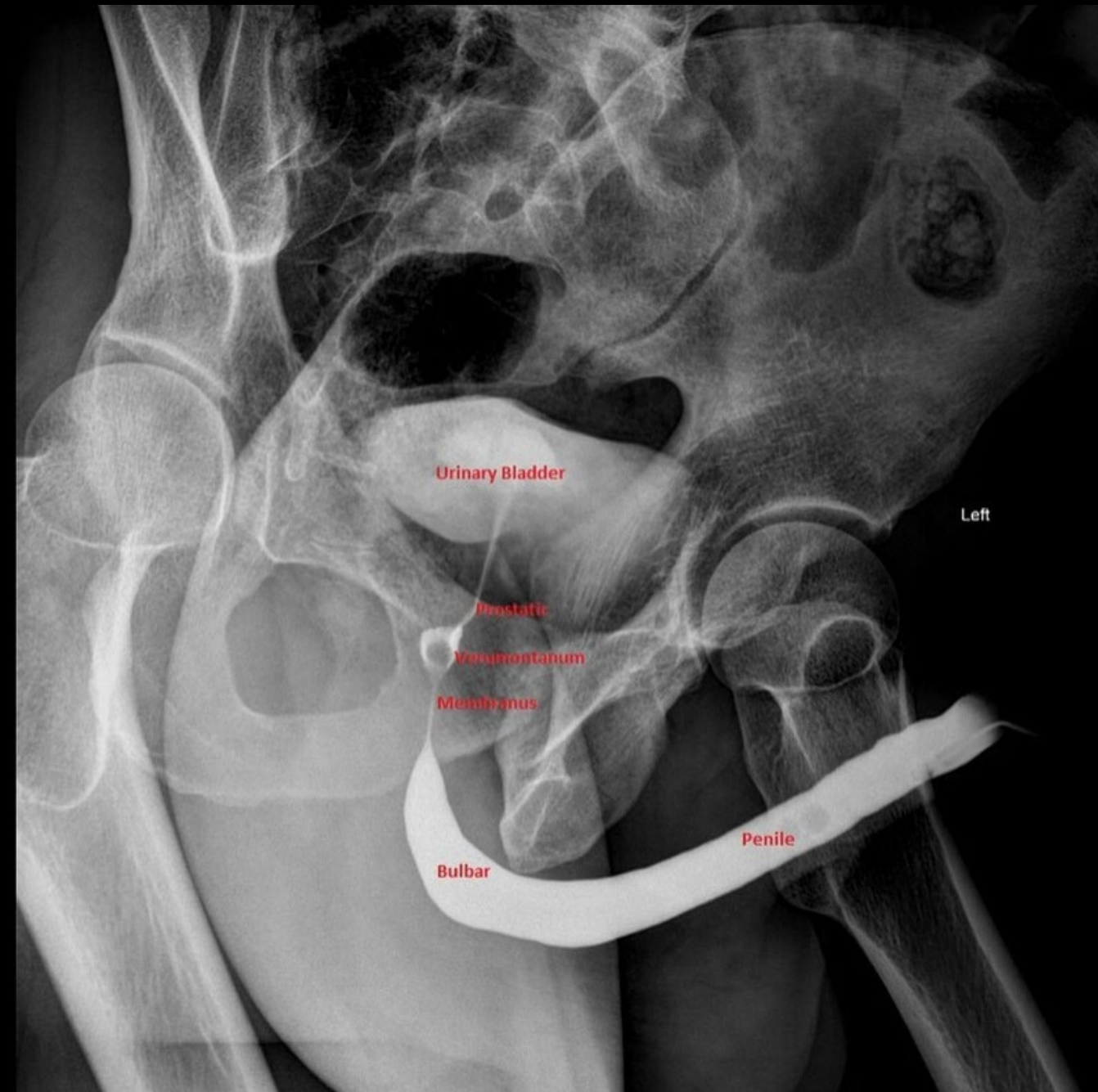
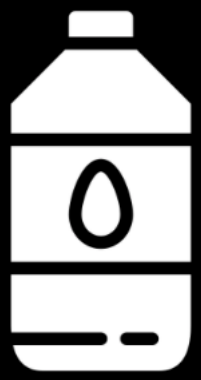


Genitourinary Management



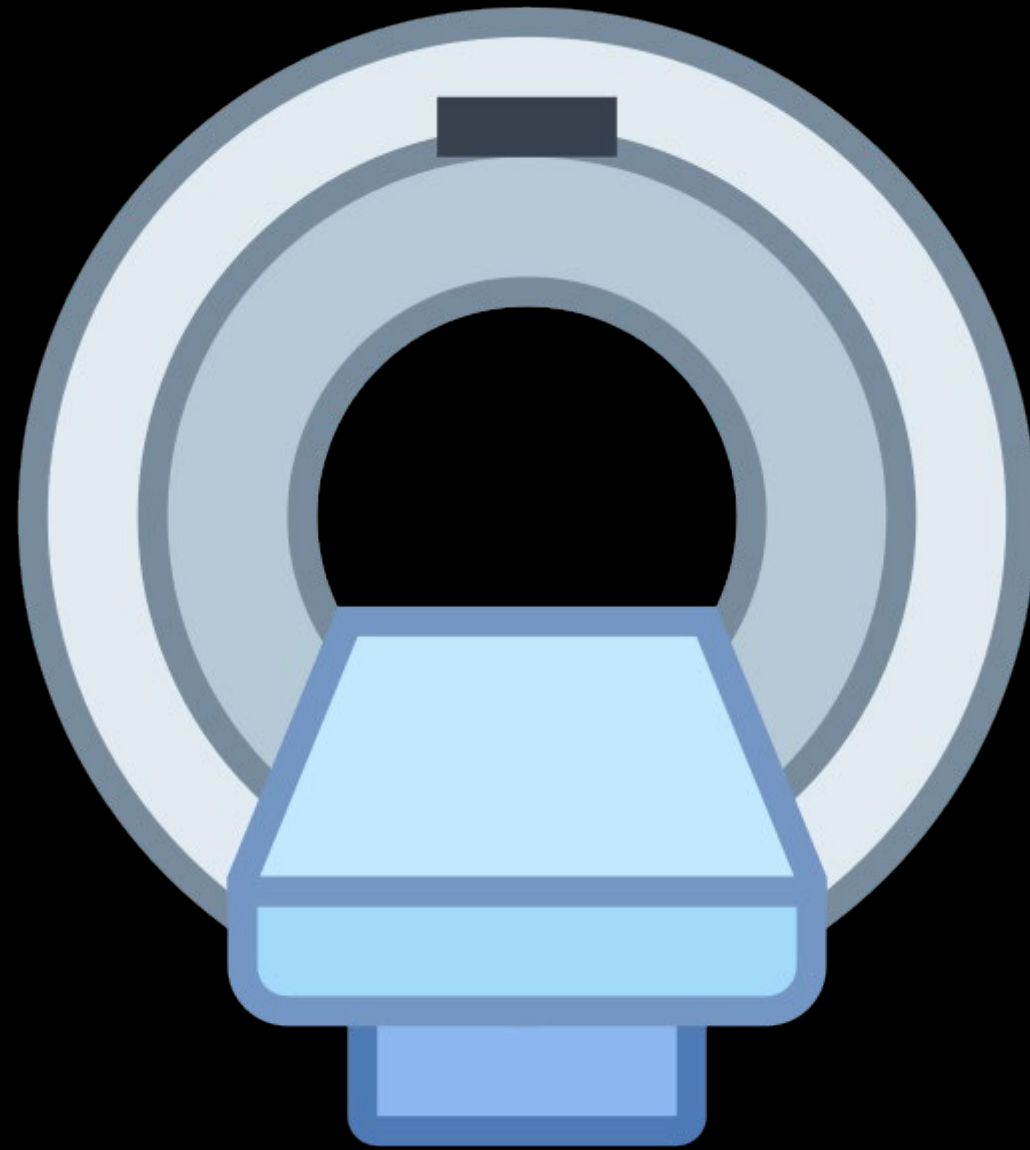
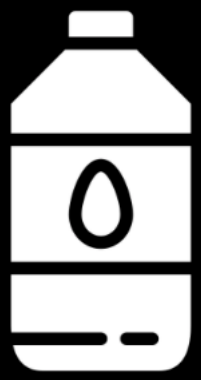
Kidney/Ureter Injury

- Microscopic Hematuria -> Upper Injury
- Macroscopic Hematuria -> Lower Injury



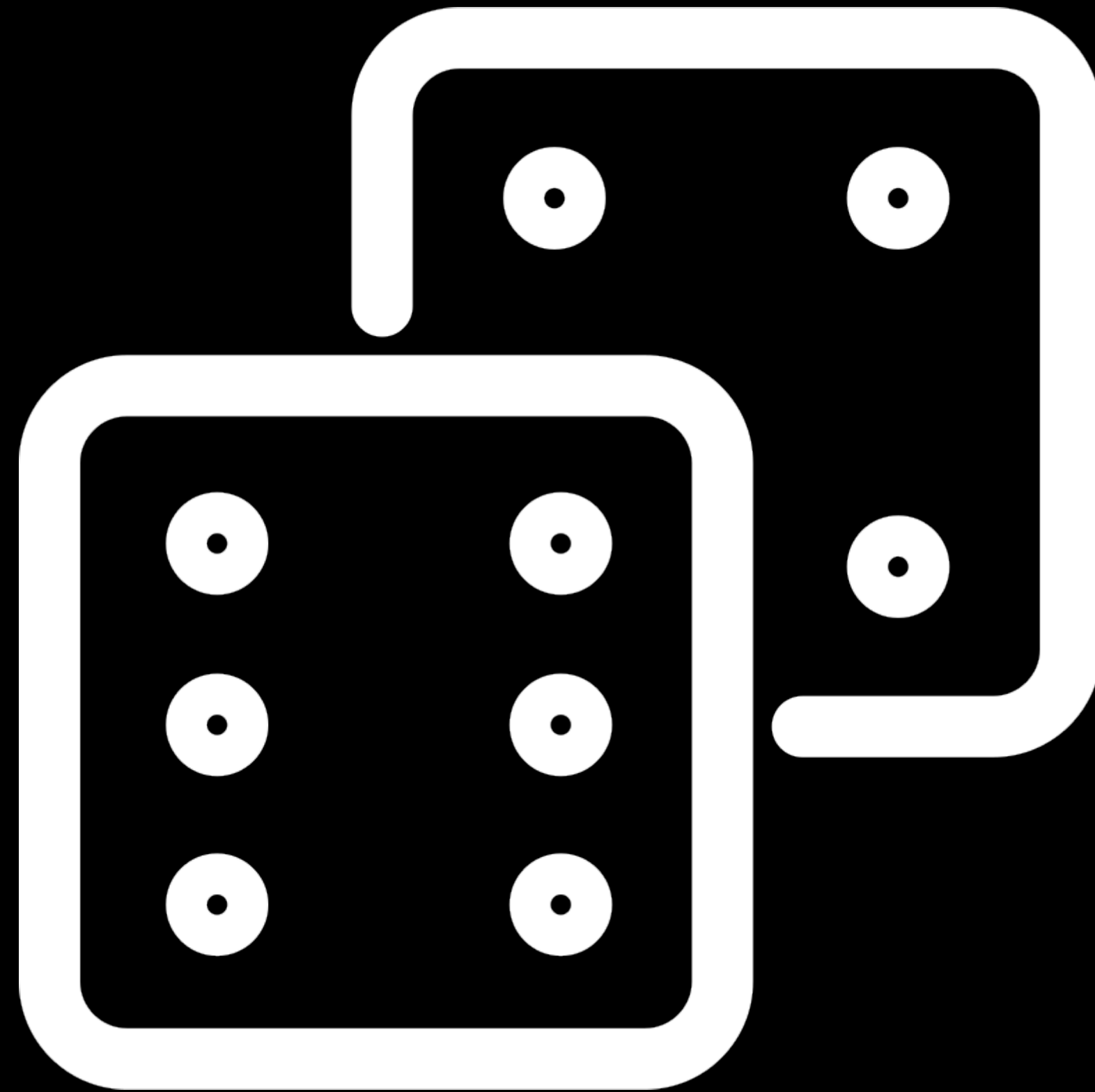
Lower Injury

- Do not place foley
- Obtain Retrograde Urethrogram

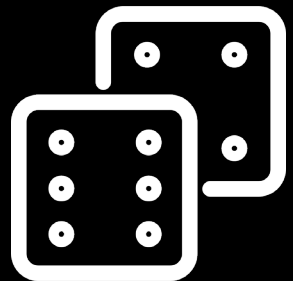


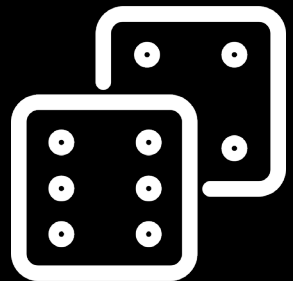
Upper Injury

- Obtain CT Scan or Renal US
- +/- Pyelogram



Random Pearls





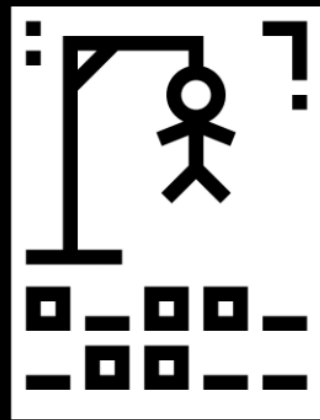
13



Summary



- PECARN for Head Injury rule out

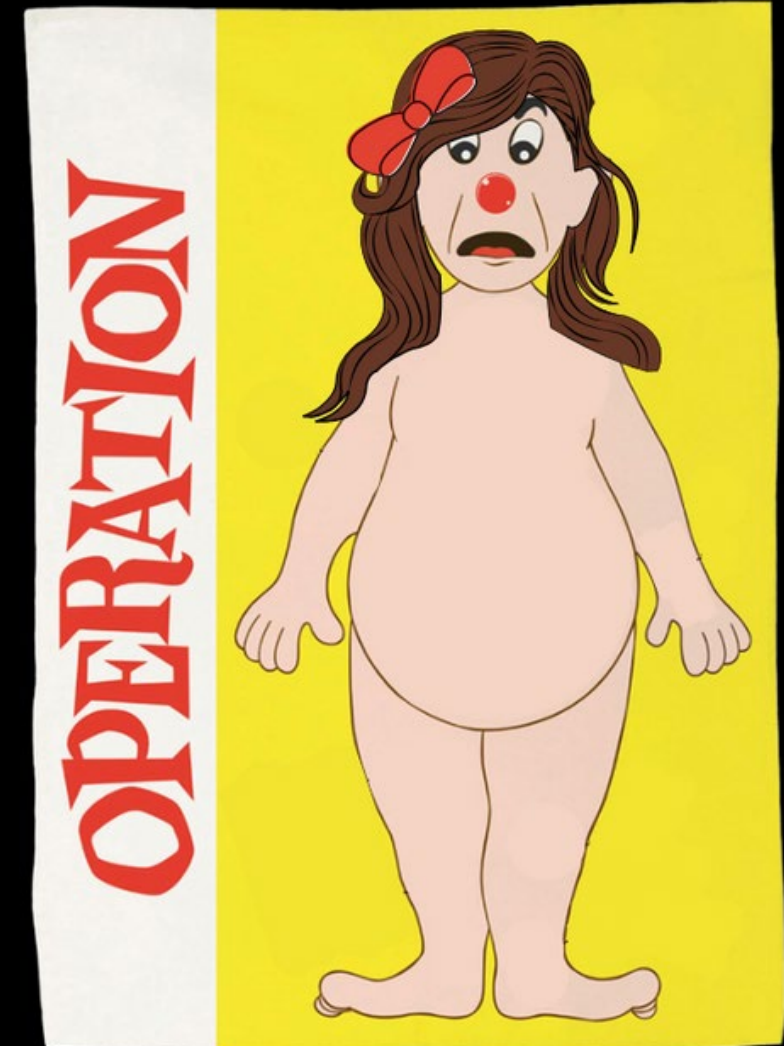


- CDRs if appropriate

- XR first unless obtunded

- CT scan if XR abnormal

- MRI for neuro sx



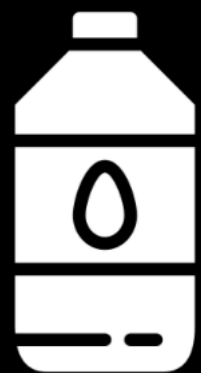
Summary



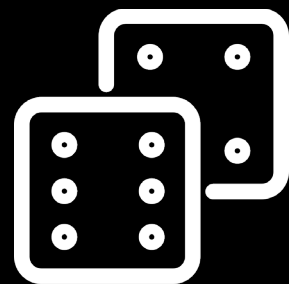
- CXR for initial evaluation
- Chest Tube 4x ETT



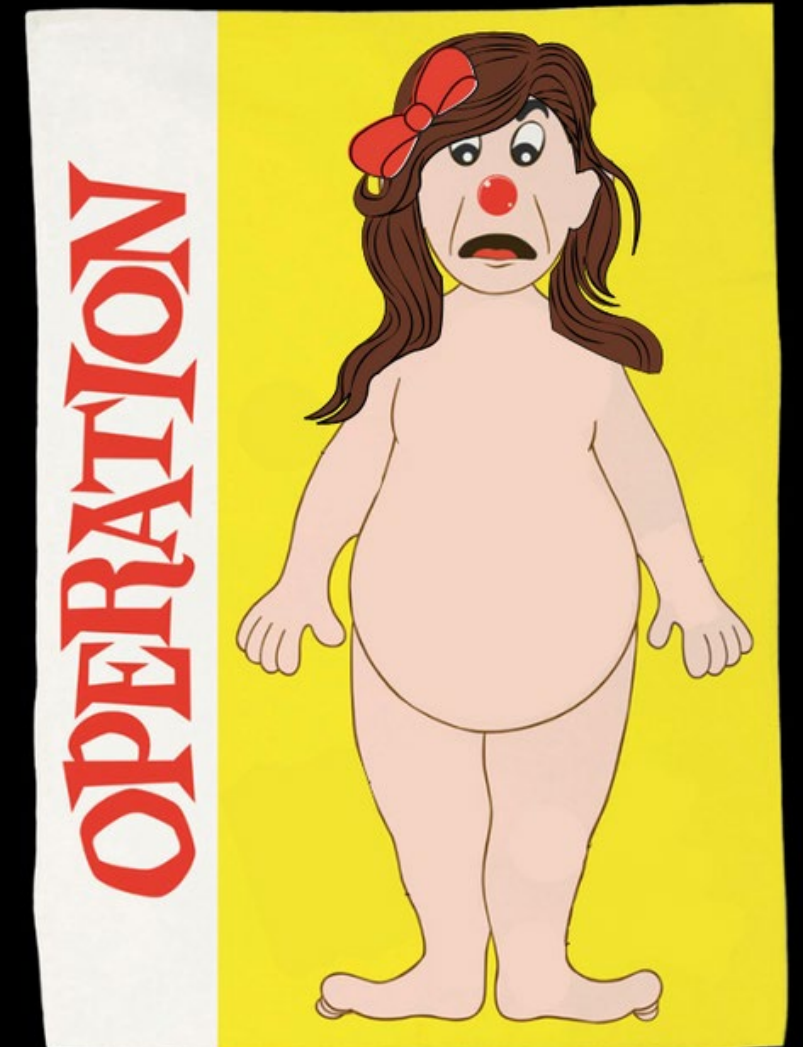
- Penetrating = Run like Adult
- Blunt – Consider serial exams



- Obtain UA to evaluate for hematuria



- UPT >9yo
- UDS >13yo





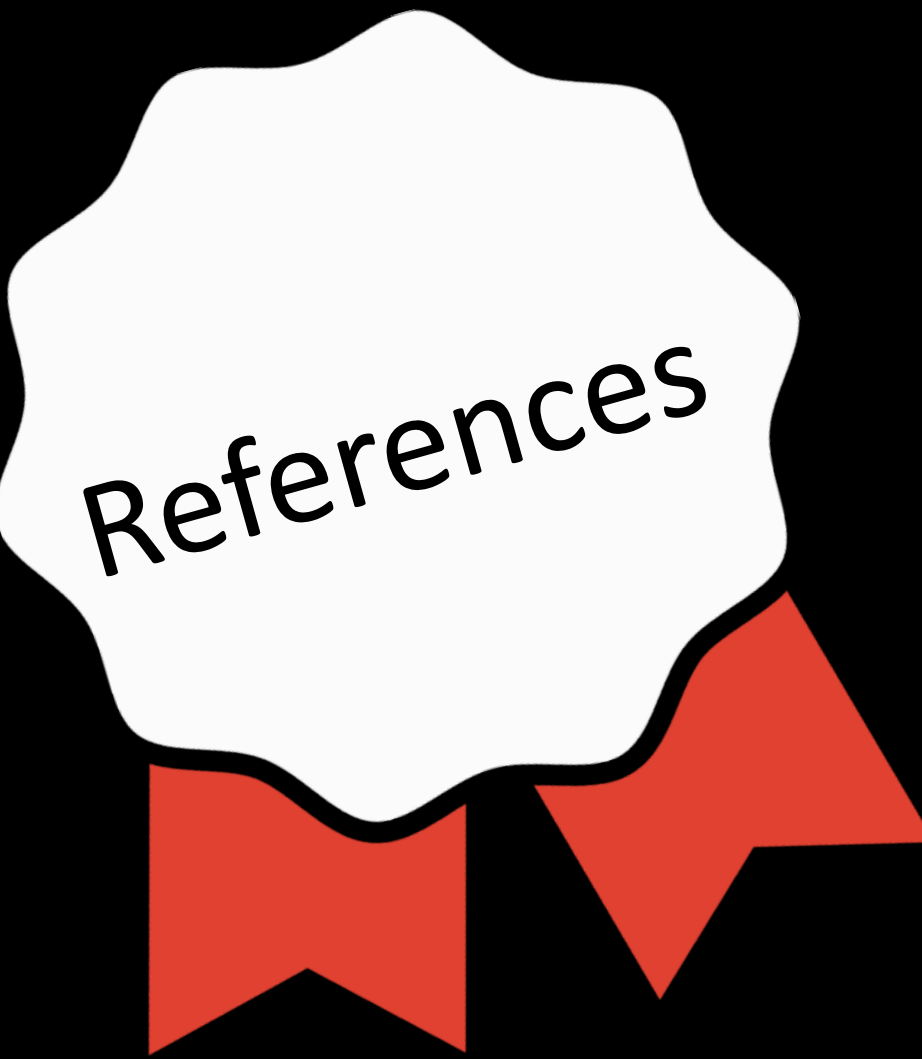
If you got all 5 questions right You
are a DOCTOR



If you got 4 questions right You
are a RESIDENT



If you got 3 or less questions right You
are a STUDENT



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All Graphics from Canva, game board graphic my own design but inspired by Hasbro's Operation